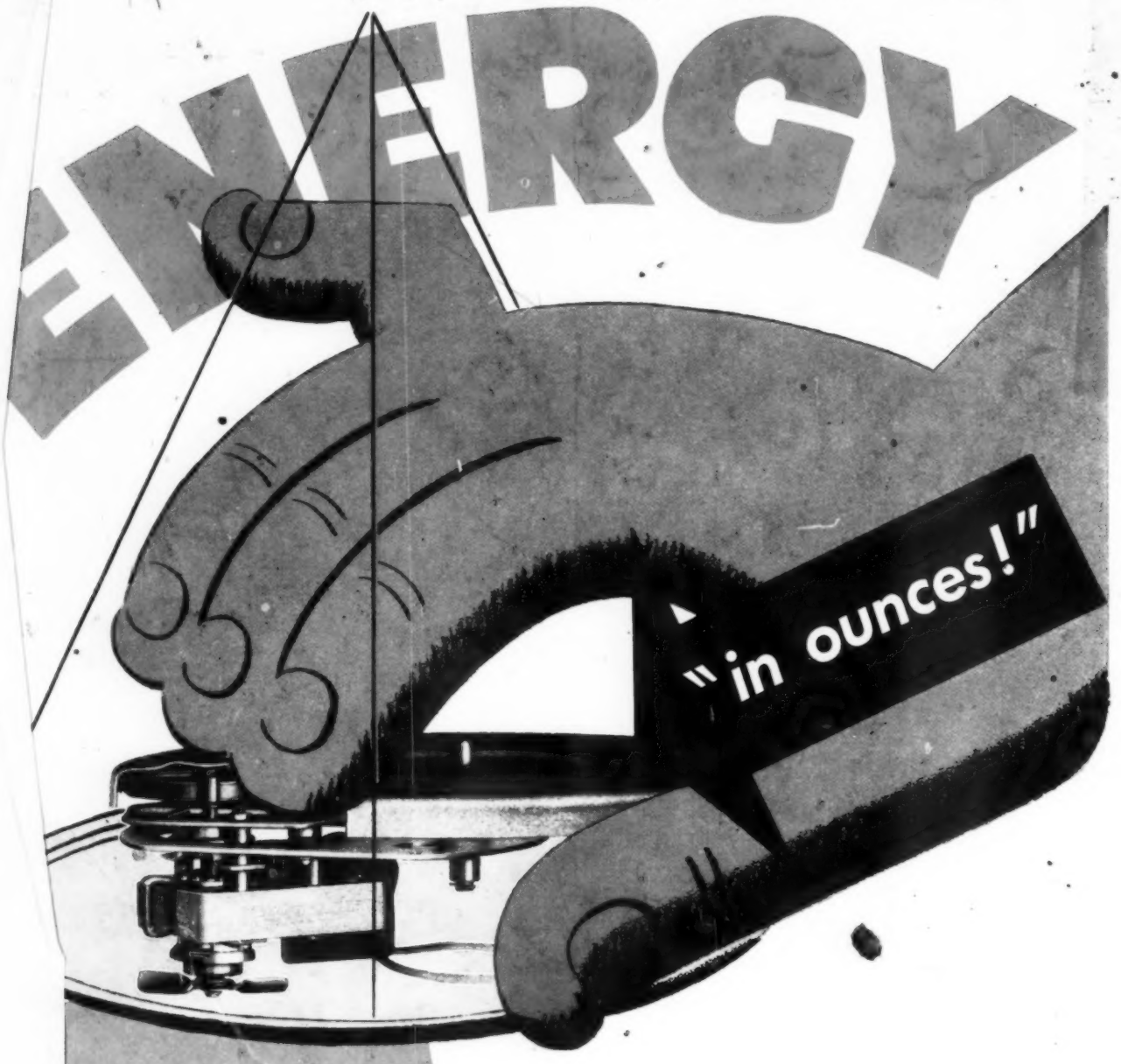
RADIO NEWS

JANUARY
194
35c

R v. 37 Jan. – June. 1947

ENERGY



nous Model 80 Even Speed Alliance Phono-
perating on 110 or 220 volts is made for
or 60 cycles, 16 watts input, 78 RPM. It has
ars—runs at an even speed—has a smooth,
positive friction-rim drive. Amply proper-
d bearings with large oil reservoirs assure
life. A slip-type fan gives cool operation—
ids any possible injury.

Alliance Model K Phonomotor, a 25 cycle com-
nion to the Model 80, operates on 110 volts, 25
ycles at 12 watt input. Motor and idler plate on
lliance phonomotors are all shock mounted to
he cabinet mounting plate, to minimize vibration.

MINIATURE MOTORS THAT
MAKE 'EM MOVE

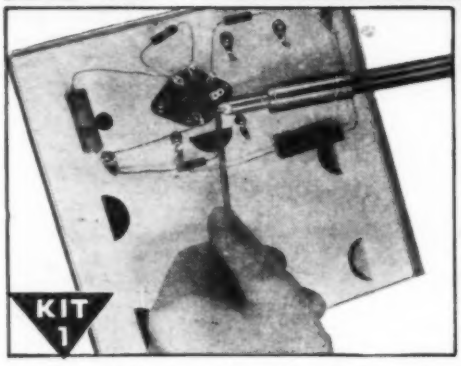
- **Light weight, compact, interchangeable power sources . . . small motors that can be mass produced at low cost are in rapidly growing demand! And Alliance has a *"Head Start"* in making millions of small electric motors.**
- ***Alliance phonomotors* drive most of the turntables, record changers and recorders for the radio-phonograph industry. And Alliance Powr-Pakt Motors rated from less than 1-400th h.p. up to 1-20th h.p. will drive fan blades, motion displays, projectors and actuate switches and controls!**
- **Write today . . . find out how Alliance Motors can help to drive your products to market!**

N YOU DESIGN—KEEP alliance MOTORS IN MIND

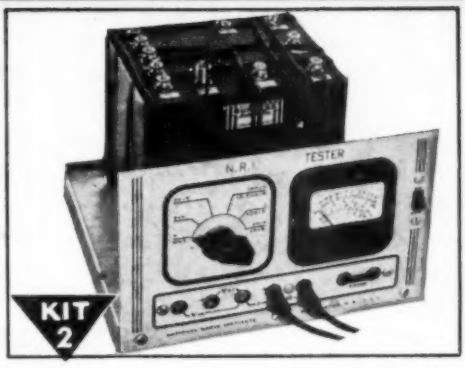
ICE MANUFACTURING COMPANY • ALLIANCE, OHIO

I Will Show You How to Learn RADIO by Practicing in Spare Time

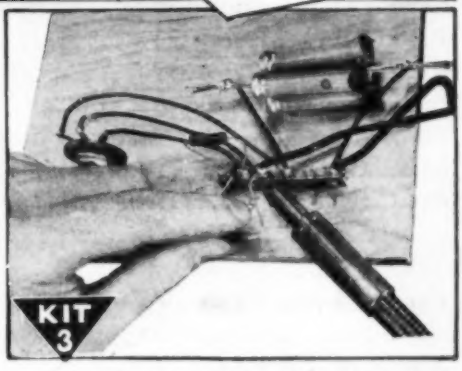
I Send You Big Kits of Radio Parts



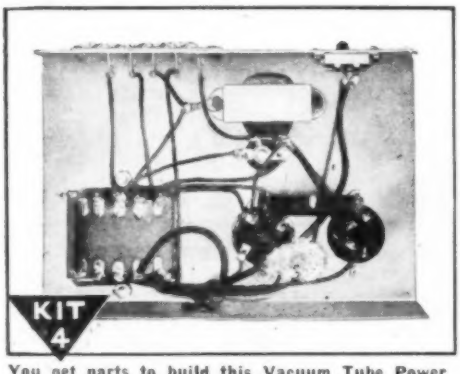
I send you Soldering Equipment and Radio parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.



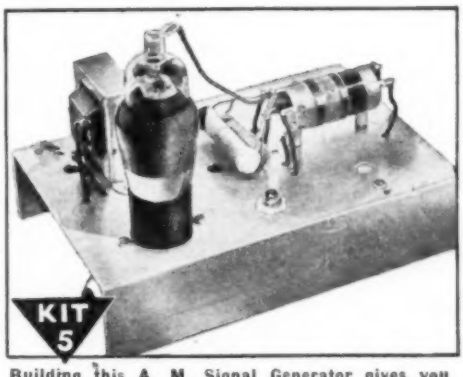
Early in my course I show you how to build this N. R. I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



You get parts to build Radio Circuits; then test them; see how they work, learn how to design special circuits; how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

I Will Train You at Home – SAMPLE LESSON FREE

APPROVED for training under G.I. BILL

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N. R. I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own full-time Radio Shop or a good Radio job!

Future for Trained Men Is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even *greater* opportunities as Television and Electronics become available to the public! Send for free books now!

Find Out What N. R. I. Can Do For You

Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal. **J. E. SMITH, President, Dept. 7AR, National Radio Institute, *Pioneer Home Study Radio School*, Washington 9, D. C.**

My Radio Course Includes
TELEVISION • ELECTRONICS
FREQUENCY MODULATION

Our 33rd Year of Training Men for Success in Radio

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Mr. J. E. SMITH, President, Dept. 7AR
National Radio Institute, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book about how to win success in Radio—and Television, Electronics. (No salesman will call. Please write plainly.)

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City ..... State .....
(Please include Post Office zone number)

APPROVED FOR TRAINING UNDER GI BILL

RADIO NEWS
REG. U.S. PAT. OFF.
First in radio

JANUARY, 1947
VOLUME 37, NUMBER 1

Average Paid Circulation over 130,000

COVER PHOTO
By Arthur E. Haug
Staff Photographer

A typical Christmas scene in a home where children and adults alike received the cherished gift of a new radio. These lucky youngsters received a Motorola "Playmate, Jr." from Santa. This little portable is a 3-power, 5½ lb. unit made by Galvin Mfg. Corp.

Other Ziff-Davis Publications: Radio-Electronic Engineering, Plastics, Flying, Popular Photography

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hallicrafters PRESENTS THE SX-42

Another first! Greatest continuous frequency coverage of any communications receiver — from 540 kc to 110 Mc

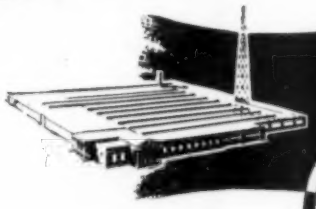
This is the long-awaited Hallicrafters SX-42, a truly great communications receiver. The tremendous frequency range of the SX-42, *greater than ever before available in a receiver of this type,* is made possible by the development of a new "split-stator" tuning system and the use of dual intermediate frequency transformers. Packed with advance features that every ham and every other radio enthusiast desires, the SX-42 clearly lives up to the Hallicrafters ideal of "the radio man's radio."

From now on watch Hallicrafters — the name that's remembered by the veteran, preferred by the radio amateur. See your distributor for demonstration of the SX-42 and for colorful literature describing this great set in complete technical detail.

Because of the precise and thorough engineering that must be done on the SX-42 and because the parts supply has not been continuous, top production peaks have not yet been reached. In the immediate future deliveries will necessarily run behind the demand, but the SX-42 is definitely worth waiting for.

$250.00
Amateur Net

Adjustable Base for "eye-angle" tuning No. B-42
$7.50 APPROXIMATE



hallicrafters RADIO
THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.
Sole Hallicrafters Representatives in Canada: Rogers Majestic Limited, Toronto-Montreal

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POPULARITY

FADA Sensive-Tone

FADA 5-tube — plus-rectifier-tube models are equipped with the new FADA "Sensive-Tone" ...assuring greater sensitivity and clearer reception.

6 TUBES
1000 SERIES

FADA

Each of the new 1946 FADA models shows that high degree of national popularity—that amazing consumer sales appeal which indicates true leadership!

FADA leadership is based upon a 25 year record of performance — superior tone, superior beauty, superior engineering . . . plus 25 years of consistent national advertising and sales promotion.

FADA leadership is reflected in sales! For greater sales—this year, and next year and the years to come — you can depend on FADA — "the radio of tomorrow — today!"

Model 602

New Superheterodyne AC Table Model Radio Phonograph Combination with Automatic Record Changer in a Cabinet of Beautiful Mahogany Veneers.

637 SERIES

Superheterodyne AC de luxe Portable Radio-Phonograph with Automatic Record-Changer.

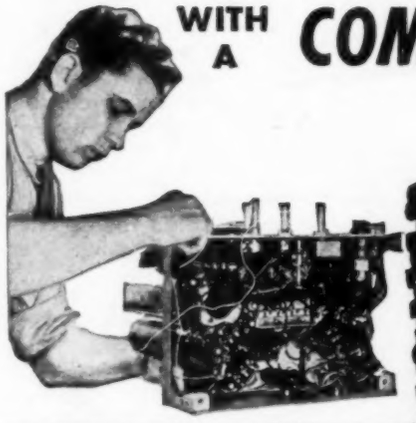
YOU CAN ALWAYS DEPEND ON

FADA Radio

Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.

NOW SPRAYBERRY RADIO TRAINING GIVES YOU 8 BIG KITS OF RADIO EQUIPMENT WITH A COMPLETE 6 TUBE SUPER-HETERODYNE RECEIVER



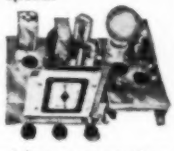
YOU LEARN RADIO SERVICING THROUGH INTENSIVE "SHOP-BENCH" PRACTICE

YOU DO EXPERIMENTS, CONSTRUCTION, TROUBLE-SHOOTING

I'll show you how to perform over 175 instructive Experiments—how to build countless Radio Circuits. You'll learn a new, fast way to test Radio Sets without mfg. Equipment.

I give you a fine, moving-coil type Meter Instrument on Jewel Bearings—with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on outside, ready-made equipment.



Soldering, wiring, connecting Radio parts . . . building circuits with your own hands—you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

HERE'S THE LATEST, SIMPLEST WAY TO TRAIN at HOME for a GOOD LIVING in RADIO-ELECTRONICS & TELEVISION

I train your *mind* by putting you to work with your *hands* on a big 6-Tube Superheterodyne Receiver. And, believe me, when you get busy with real Radio Parts — 8 big Kits of them — you really LEARN Radio and learn it RIGHT! You get the practical stuff you need to be *useful* in Radio, and that's what it takes to make money. You don't have to worry about what to do with these 8 Kits of Parts. Step by step, I show you how to build circuits, test, experiment, trouble-shoot. And you don't need any previous experience. The Sprayberry Course starts right at the beginning of Radio! You can't get lost! Simplified lessons, coupled with real "Shop" practice, makes every subject plain and easy to understand and remember.

A BUSINESS OF YOUR OWN . . . OR A GOOD RADIO JOB

Soon after you begin Sprayberry Training, I'll send you my sensational BUSINESS BUILDERS. You'll find out how to get and do neighborhood Radio repair jobs for nice profits and rich experience while learning. This sort of work can easily pave the way for a Radio Service business of your own. But with Sprayberry Training, you're not limited. You can swing into any one of the swiftly expanding branches of Radio-Electronics INCLUDING Radio, Television, FM, Radar, Industrial Electronics. Be wise! Decide now to become a fully qualified RADIO-ELECTRONICIAN. Get full details about my Training at once! Mail coupon below for my 2 big FREE Books.

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Here's a valuable and wonderfully complete new book which explains in simple English how to read and understand any Radio Set Diagram. Includes translation of all Radio symbols. Send for this volume at once! It's free! Along with it, I will send you another Big Free book describing in detail my Radio-Electronic Training.

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F. L. Sprayberry, President, Room 2517, Pueblo, Colorado

Please rush my FREE copies of "How to MAKE MONEY in RADIO, ELECTRONICS and TELEVISION," and "HOW to READ RADIO DIAGRAMS and SYMBOLS."

Name ..... Age .....

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City ..... State .....

(Mail in envelope or paste on penny postcard)

For the RECORD.

BY THE EDITOR

SINCE V-J Day independent radio service dealers have limped along on a starvation diet of tubes and replacement parts and have had but few new radio receivers to offer their customers. But they have been given an oversized stock of advice on how to run their businesses and have been oft told about their reputed failings.

We were talking with some dealers recently about a meeting they had attended where the speaker proclaimed that the radio manufacturer was not obligated to the radio serviceman in any way. He had said, in effect, that the manufacturer had *his* job to perform and the serviceman had *his* job to do. If the manufacturer cooked up some tricky innovation in a circuit, he wasn't obligated to tell the serviceman. It was up to the repair man to figure out that cunning little wrinkle when the receiver bobbed up in his shop for repairs.

These dealers too were talking about the flood of postwar radios that were already flowing into their shops for service. These sets are supposed to be those marvelous new postwar radios, brimming over with all of the improvements which wartime design and production genius had devised, according to the glowing picture painted by much wartime advertising, that is. They were damning brand-new receivers with unsoldered leads, with poor quality speakers where the slightest trace of damp weather caused the voice coil to kiss the pole piece with a raucous noise, of tubes that tested o.k. in the tube checkers, but wouldn't function in the set. They were fixing a lot of these postwar sets and trying to protect the "vaunted" reputations of many a first-line radio manufacturer.

The home radio industry has never appreciated nor recognized the important and indispensable contribution the independent radio serviceman has made to the radio industry. The average radio serviceman came into the business through a love for tinkering with radio circuits and a sincere desire to have a small business of his own. Usually he possessed little or no knowledge of business fundamentals or even an understanding of what makes a retail business click. He just set up shop, repaired whatever radios were brought in to him and hoped enough business would come in to keep the wolf from the door.

The radio receiver, without a circuit diagram or other information about the designer's peculiar innovations, can stop even the best radio service engineer unless he takes the time to analyze the assembly carefully, component by component. Yet, manufacturer after manufacturer threw receivers on the market without supporting technical information that would help the neighborhood serviceman to whom the purchaser would logically turn for help when the set failed to function. Eventually the circuit would appear in print, perhaps a year or two later, but this was of small help to the conscientious and hard working guy who had the set dropped in his lap for repairs three months after it was purchased.

The radio industry generally has failed to support this valuable arm of the radio business. As an industry, it has not supplied the service dealer with instructive material on basic circuit developments, components and replacements, tube performance data and anything helpful industrywise that would materially aid the independent dealer do a faster and better job of keeping the customer's radio set working—that is until an aggressive group of service specialists, recognizing the need for complete servicing data schematically, pictorially and practically, undertook the job. This independent organization analyzes every available model as fast as it leaves the makers' production lines and immediately prepares complete data now available to the serviceman at frequent intervals, even before many new models reach his establishment.

The novelty of radio in the early days materially influenced the buying public to pay for rapid obsolescence of expensive home receivers. It also generated some unsound thinking on the part of many radio manufacturers who are failing to see, even today, that the radio industry has grown up! Radio is no longer a fascinating novelty in the public eye and the days of "anything goes" are over. There is a growing public demand that the new radios they buy must not only perform far better than prewar sets, but they must also possess the stamina promised through wartime developments. This is also expected of FM, television and facsimile, as well as appliances sold today by many radio dealers.

Radio service dealers today are being criticized because they have failed to equip themselves to handle television servicing. But howinell *can* they —when the makers' service data remains "top secret"? There has been some talk that larger television manufacturers plan to handle their own television installations and servicing. One rumor recently heard was that a group of manufacturers planned to pool their service activities into one large service company that would handle the installation and servicing of all their TV receivers. We do not

(*Continued on page* 155)

Order Your Communications Receiver from ALLIED

You Get Earliest Delivery from ALLIED

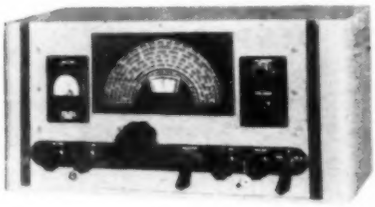
because ALLIED is the world's largest distributor of communications equipment. Naturally, we receive manufacturers' shipments quickly—and these shipments of highly diversified gear are completely centralized for faster handling. All this means that *you* get faster service on your orders—handled, of course, with customary ALLIED efficiency and expert attention. *Your orders to ALLIED are orders for earliest delivery.*

NEW!

HALLICRAFTERS SX-42

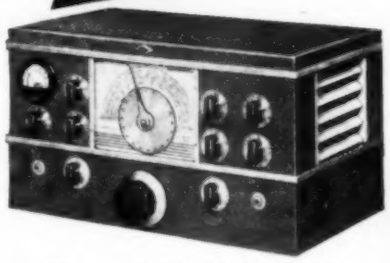
Here's the NEW SX-42—the receiver that sets a new standard in radio performance. Covers everything: Frequency range of 540 KC. to 110 MC. brings you high-fidelity broadcast reception—world-wide Short-wave coverage—PLUS true high-fidelity FM broadcast reception (all FM frequencies), and hi-fi phono reproduction. The new SX-42 is brilliantly designed to bring you more features, more operating thrills than you've ever thought possible. Wide-vision no-glare dials, AM-FM signal level meter, six-position selectivity control, dual IF system, separate sensitivity and volume control, NEW SIMPLIFIED controls for family use. Designed for top-flight reception—in the home, or for Amateur and Commercial communication work.
Net, less Speaker..... **$250.00**

Time Payments **Trade-Ins Accepted**



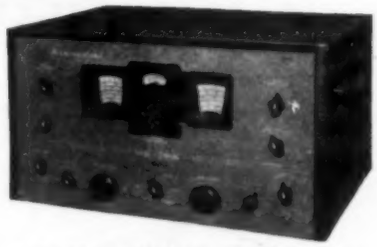
THE RME 45

The famous RME 45 Receiver delivers peak reception on all frequencies—550 to 34,000 KC. Features full-vision calibrated dial using a single control for two-speed tuning. Includes five Amateur bands with ample band-spread. Has DB-calibrated signal level meter; 5-step variable crystal filter; Automatic Noise Suppression; stable, variable-pitch beat oscillator, and a host of other features. Housed in handsome streamlined metal cabinet with matching speaker.
Net, with Speaker..... **$198.70**



NATIONAL NC-2-40D

One of National's top receivers. Covers 490 KC. to 30 MC. range in 6 tuning bands. Has definite, accurate calibration for all bands. Features efficient single-dial control. Famous for its stable high frequency circuits. Frequency drift is reduced to a negligible value by temperature compensation. Has automatic band-in-use indicator. Wide-range adjustable series-valve-noise limiter. Flexible crystal filter. Special r.f. coupling circuits maintain full sensitivity.
Net, less Speaker..... **$225.00**
Speaker in matching cabinet, *Net*..**$16.44**



HAMMARLUND HQ-129-X

Designed to meet the most critical demands of professional operators. Full range, .54 to 31 MC. accurately calibrated. Has 4 calibrated Ham bands and one arbitrary scale. Variable selectivity crystal filter. Low-drift beat oscillator for code and locating stations. Antenna compensator. Voltage regulation. Automatic noise limiter. Compensated oscillator to reduce drift during warm-up. Earphone jack. Three i.f. amplifier stages. Two audio stages. Speaker supplied in matching metal cabinet.
Net, with Speaker..... **$173.25**

Other Communications Receivers

Hallicrafters S-38	$39.50	RME-84	$98.70
Hallicrafters S-40	79.50	RME VHF-152 Converter	86.60
Hallicrafters S-36A	307.50	RME DB-20 Preselector	68.20
National NC-46	97.50	National HRO	274.35
NC-46 Speaker	9.90	Hammarlund SPC-400X	342.00

Net F. O. B. Chicago. Prices subject to possible change.

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Everything in Radio and Electronics

RADIO JOBBERS*–DEALERS–SERVICE MEN

HERE'S HOW Federal Helps You to Bigger Profits and Better Service, with the New Miniature Selenium Rectifier

Everybody benefits from Federal's miniature 5-plate selenium rectifier — the new replacement for rectifier tubes in all AC-DC radio receivers. Jobbers and dealers get a fast-moving item that will ring up added profits . . . radio repair men earn extra money and give better service . . . and the customer gets finer performance from his set.

Since the first announcement of these miniature rectifiers, the response has been tremendous — but production is in full swing and you can still get all you want, when you want them.

And now, Federal offers you these three big sales-boosters, to help you cash in on this new market. They're free with every order, even if it's for only *one* standard package. But the supply of these sales helps *is* limited, so be sure to send for yours today! Simply fill in and return the coupon below.

***RADIO JOBBERS** — *these "sales promoters" will help you to build up a big demand for this new radio component. And Federal welcomes inquiries regarding territories now available for jobbers and sales representatives to handle the new Miniature Rectifier.*

1. FREE SALES-CREATING WINDOW POSTER

This big 17-by-22 inch, 3-color poster, mounted on your window, wall, or counter, will let prospects know that you have this remarkable new rectifier for sale. It gives all the sales points at a glance — the facts that will turn prospects into customers.

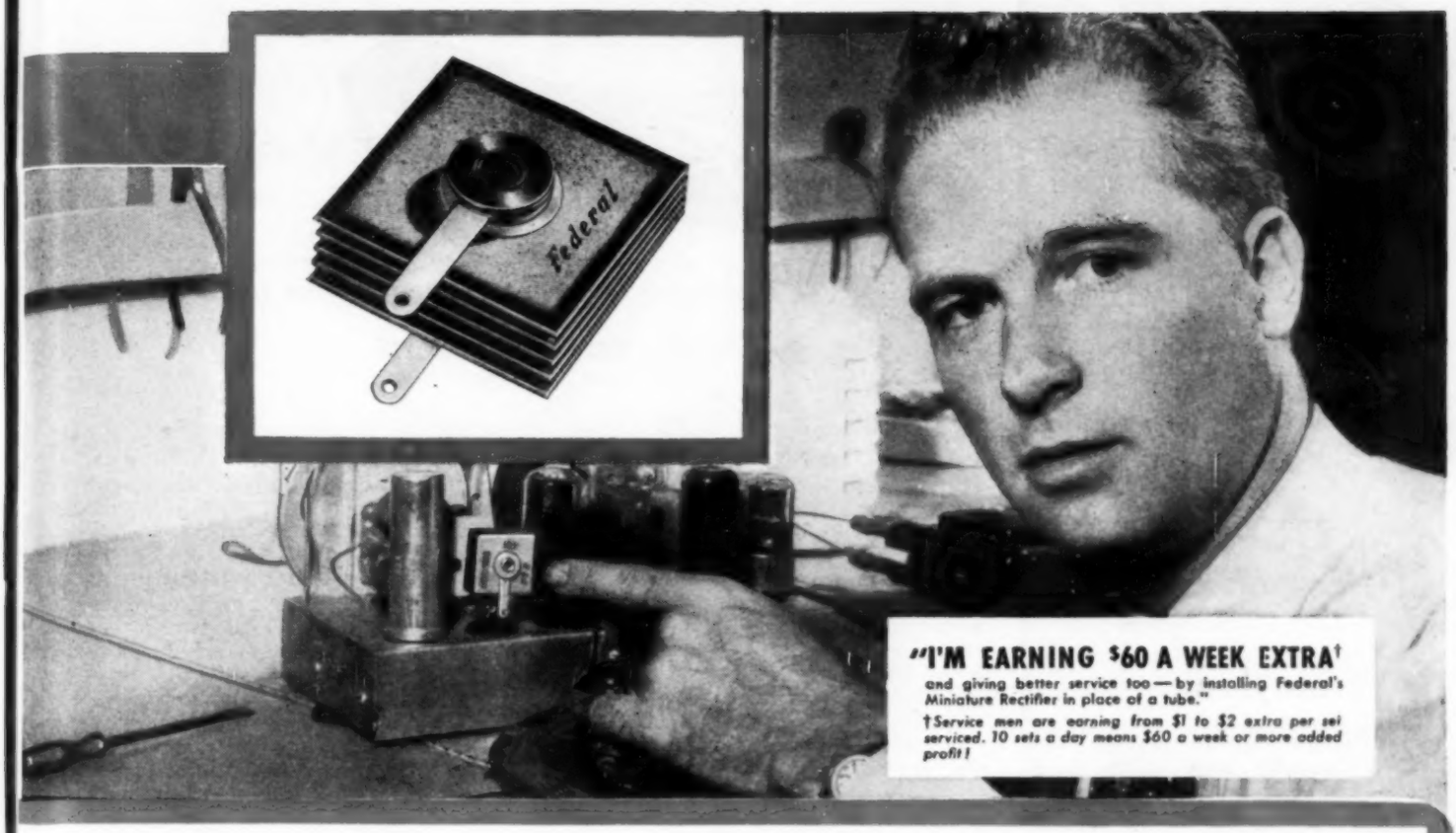
2. FREE SELF-SERVICE COUNTER DISPLAY

Each standard package of 12 rectifiers opens up into this striking 3-color "self-service" counter display — an automatic salesman that makes it easier for your customers to buy. And every rectifier unit is individually boxed in an attractive carton. They stack neatly on your shelves and take up very little space.

Federal Telephone and Radio

An IT&T Associate — Federal Telephone & Radio

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal.
Export Distributors:—International Standard Electric Corp. 67 Broad St., N.Y.C.

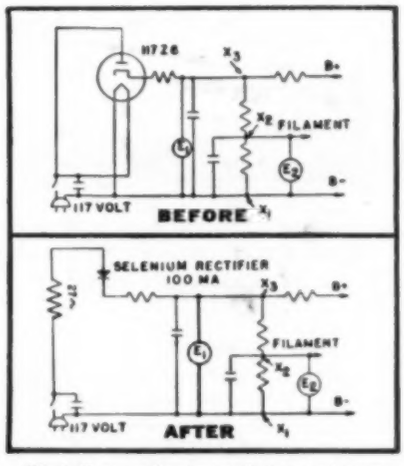


"I'M EARNING $60 A WEEK EXTRA†
and giving better service too — by installing Federal's Miniature Rectifier in place of a tube."

†*Service men are earning from $1 to $2 extra per set serviced. 10 sets a day means $60 a week or more added profit!*

3. FREE "HOW-TO-DO-IT" SERVICE MANUALS

Seven valuable service manuals, including an instructive 8-page booklet which gives simple, step-by-step directions for installing Federal's miniature rectifier in place of a tube. "Before-and-after" circuit diagrams, plus detailed photographs, show what to do and how to do it. You'll be surprised to find how easy it is.



Circuit diagrams showing installation of miniature rectifier in a Motorola "Playmate."

ORDER YOUR FEDERAL MINIATURE RECTIFIERS TODAY— SHIPPED BY RETURN MAIL

FEDERAL TELEPHONE AND RADIO CORPORATION
200 Mt. Pleasant Ave., Newark 4, N. J. Dept. F959

Yes, Federal — I want to cash in on your offer. Send me number of packages checked below — plus complete sales accessories. (☐ check or ☐ money order enclosed)

SELENIUM RECTIFIER, 403D2625, 100 Ma

QUANTITY	PRICE*
☐ 1 Package (12 Rectifiers)	$12.00
☐ 4 Packages (48 Rectifiers)	48.00
☐ 8 Packages (96 Rectifiers)	89.28
☐ 12 Packages (144 Rectifiers)	129.60

No order accepted for less than one package.

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Spot Radio News

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By **FRED HAMLIN**
Washington Editor, RADIO NEWS

PRODUCTION TRENDS during the coming year will be toward quality and away from quantity, late-1946 market conditions indicated. Even before OPA ceilings were off table sets, supply was far enough ahead of demand to result in price wars in some metropolitan areas. At year-end, small-model inventories in retail outlets were ample. It follows that new-year production programs will accent console sets. Lagging items—FM-AM receivers, radio-phonograph combination consoles, and television sets—were beginning to perk up even early last fall, and should make the headline production story when the score is in for 1947. But don't discount the importance of table sets in the '47 market. They'll be evident in large numbers in the FM-AM field, and welcome to them. FM stations are particularly eager to see the small sizes in big production to build a listening audience large enough to attract advertisers.

FIRST BREAK in television production was dramatic—during September, 3242 units were turned out, as contrasted with a total of 225 for the previous eight months. Other items moved upward, receivers with FM facilities totalling 17,541 as compared with 13,892 in August. Console combinations hit a new high of 105,344—ahead of the same month in 1941, corresponding pre-war period. Two of the chief blocks to big production seemed on the way to elimination, with an increased supply of lumber and gang condensers coming off the fall production lines. More of the big sets appeared monthly in the fall and early winter, and indications are that '47 would be a banner year.

THE NEW YEAR will certainly be significant so far as television broadcasting is concerned. Latest available figures indicate that a total of thirty-seven stations should be broadcasting before mid-year, with more than forty additional applications under consideration at the Federal Communications Commission . . . FCC also began early in December to consider the problem brought up by commercial color television stations and the technical assets of this kind of equipment. *Columbia Broadcasting System* is behind this one and seeks permission to operate in the band 480 to 920 megacycles. Enthusiasts for color predict wide use of the media for outdoor as well as studio picture-casts, day or night.

NOT TO BE OVERLOOKED in the radio fireworks for '47 are FM broadcasting activities, which promise plenty of excitement—and competition. Reports from the field indicate that any FMer who is on the air and in full swing by mid-year will be lucky, but from then on the going should be good. Chief causes for delays are two—set production will not catch up with demand for at least six months, and most new stations are having difficulty finding good broadcasting sites—high land is essential. Production promises to be on the way to catching up with demand by mid-year and experts are predicting that as many as 30 per-cent of the listener audience will be confirmed FM enthusiasts by January, 1948.

STATION COMPETITION promises to be stiff in highly concentrated population areas. FCC has pending a high of thirteen FM applications in the New York City area, Chicago is second with twelve, Los Angeles has asked for ten, Boston, Cleveland, and Washington eight, Pittsburgh and Indianapolis seven. A few stations are already on the air. Commercially, even ones that are yet to open report ready acceptance from advertisers. Time has been sold for WRCM, New Orleans, and KOPY, Houston; also for projected stations at Allentown, Pa., and Evanston, Illinois. Best advertising slogan comes from KOZY, Kansas City pioneer station: "FM Means Folding Money—for You."

ADVERTISING in the FM field already shows signs of jumping into the battle between FCC and the AM networks on the length and quality of advertising blurbs. The FM boys show signs of siding with FCC in the battle. Typical is an announcement by WQQW, FM-AM outlet operating in the Washington area. "No commercials will be permitted longer than one minute," says station policy. "At least fourteen minutes free of advertising will proceed and fourteen minutes of free advertising will follow each commercial." Admitting that "the majority of listeners are enthusiastic

SPOT RADIO NEWS

about commercial radio as it is," the station reports that "a minority—roughly one-third of the population—is dissatisfied with excessive commercialism" and proposes to "appeal particularly to advertisers seeking to reach that audience."

Quality of advertising copy will also be reviewed before it goes on the air. "The station will seek to insure that the products advertised, the claims made, and the advertising copy used will conform to the station's policy to reach "intelligent listeners." . . . If all this seems to be words from the mouth of FCC, it is perhaps worth adding that general manager at WQQW is Edward M. Brecher, from 1941 to 1945 assistant to FCC chairman James Lawrence Fly and subsequently a special analyst in FCC's law department. But the station's policy perhaps indicates a significant trend—FM's determination to bring advertising quality up to the quality of FM broadcasting. Whether it will succeed is one of the interesting $64 radio questions that may be answered in 1947.

NON-PROFIT FM STATIONS will also figure in the broadcasting new deal. More than sixty educational institutions are already licensed, have received initial authorization or have applied to operate non-profit stations as this goes to press. Six stations are already on the air. Indications are that most states plan to establish networks linking county and municipally operated stations into state-wide systems. The early-bird interest of schools and colleges in the new radio equipment came as no surprise to FCC—educational institutions, it reports, were among the pioneers in broadcasting, at witness WHA of the University of Wisconsin, oldest university-operated station, which has furnished uninterrupted service for a quarter of a century. . . .

WASHINGTON may become national headquarters for FM broadcasters, following preliminary meetings there this fall and early winter toward organizing into an association. As this goes to press, major policies were being worked out to formalize the group and decide how wide to set the scope of its membership. That the new outfit will not be lacking in enthusiasm is indicated by a recent statement by Everett M. Dillard, KOZY head in Kansas City and also licensee for WSDC, Washington. Said Mr. Dillard: "If I were to tell you of a new atomic propelled automobile which would replace our present gasoline propelled type of vehicle, you would be startled and aware of a new era in transportation. FM, so far as radio is concerned, is to AM what atomic power in the automobile would be to gasoline power. Nothing can stop it!"

FM PROGRAMMING is one of the most serious problems on the immediate horizon. Chief hope of new sta-

(*Continued on page* 18)

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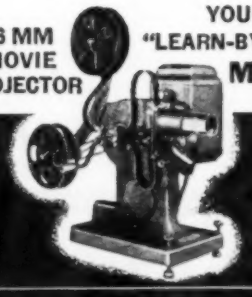

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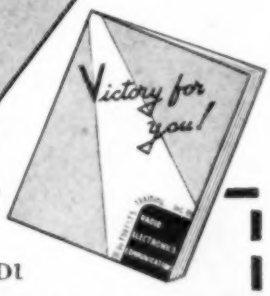

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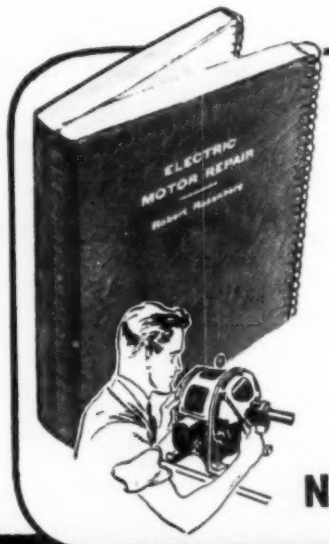

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Teleran will, of course, be less expensive than radar equipment—Jones estimates that with a mass market a unit can be bought for as little as $500. Although this price is still high for the average amateur pilot, Jones feels that the system will pay off in safety and efficiency when there are enough planes in the air to make installation worthwhile. . . . Regardless of the future, FCC is regarding it as a potential factor in the airways of the future, and if it develops, even to a small degree, it should open new vistas—not to mention a number of new jobs—for those interested in electronics.

IF YOU OWN a taxi-cab radio unit, you can tune in on other two-way taxi radio hook-ups clear across the country, according to frequency assignments recently announced by FCC. Same thing applies to other radio systems now being assigned to urban use. Reason for the assignments is that FCC has been flooded with demands for experimental operations in the field of general mobile service in big cities. To meet the demands, the Commission devised a temporary frequency assignment plan to be followed so that everybody has an opportunity to see if the radio is fitted to his needs. Assignable channels for land stations and mobile stations are six—152.03 mc., 152.15 mc., 152.27 mc., 152.39 mc., 152.51 mc., and 152.63 mc. The same number of channels have been assigned for mobile stations only —157.29 mc., 157.41 mc., 157.53 mc., 157.65 mc., 157.77 mc., and 157.89 mc. Channels 152.27 mc. and 157.53 mc. may be assigned to taxicab systems, while department stores, delivery services, ambulance services and the like will get 152.15 mc. and 157.41 mc. Other channels will go chiefly to experimenters in the field and to existing general communications common carriers. "In no event," FCC has ruled, "will any land station be permitted to use a mobile frequency" without a mobile hook-up.

CLOSELY LINKED with these channel allocations was FCC's recent announcement following recommendations from all parties concerned that readjustments were being made in allotments in the 152-162 mc. band. Chief reason was given as "the desirability of having a standard international maritime band in the v.h.f. region—a need recognized at the meeting on radio aids to marine navigation in London. At this meeting it was revealed that the United Kingdom had already allocated four pairs of single channels each 100 kc. wide between 156 and 162 Mc. U.S. representatives faced with "insurmountable" obstacles in obtaining agreement on frequencies elsewhere in the v.h.f. spectrum, decided to go along with the British allocations. . . .

FCC reports big activities in the maritime radio field, and a bright future. Safety and distress services will be standardized as the result of the international agreements, and communications are developing rapidly between ships of all nations and land bases associated with shore-based radar transmitters and harbor control facilities. Fog as a major menace in crowded sea lanes will, it is implied, soon become a thing of the past. Another aspect of marine radio with a brightening future is the use of v.h.f. radiotelephone from ship to shore near large ports. Radio will also figure more markedly as an intercommunication device in inland waters, especially among all types of water craft on rivers, lakes and oceans connecting the United States and Canada and the United States and Mexico.

TWO INTERESTING developments in the experimental field showed up a few weeks ago on the FCC dockets. One was the granting of a permit for an experimental class two station near Cleveland, Ohio, to be used in connection with development and testing of facsimile equipment. The permit went to Acme Newspictures, Inc., which is to say to the United Press, Scripps-Howard newspapers and other affiliates. It includes permission to experiment with transmitting pictures over long distances—to Acme posts in Europe and South America. Frequencies: 3492.5 4797.5, 6425, 9135, 12862.5, 17310, and 23100 kc. on a temporary basis; power 1000 watts; A4 emission

(*Continued on page* 166)

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Model H	250 Ohms	25 Watt	$0.98
Model H	125 Ohms	25 Watt	.98
Model J	1800 Ohms	50 Watt	1.25
Model K	3000 Ohms	100 Watt	1.98
Model L	250 Ohms	150 Watt	2.25
Model L	100 Ohms	150 Watt	2.25
Model N	22 Ohms	250 Watt	3.00
Model P	1200 Ohms	225 Watt	2.75

Other ratings in stock in ohmite, Clarostate and Deier. Inquire.

D.C. HAND GENERATOR TYPE GN-45-B

Output; 6 volts at 3 amps. and 500 volts at .14 amps. Rated speed: 60 r.p.m. Used but in perfect condition..... $5.75

A. **VHF Variable Condenser.** 15-60 mmf. ⅝" air gap. 11 rotor plates, 6 stator, with feedback provision. Designed to operate in a tuned grid, tuned filament circuit. Listed at $148. Our price **$14**

B. **Split Stator.** Cardwell PK-200-QD. 30-200 mmf per section. Special Hi-Volt. Listed at $65..... **$9.95**

C. **Johnson Type 500D35.** Maximum cap. 500 mmf, min 35 mmf, .08" spacing, 3500v. Listed at $11.75. Lowered to.. **$4.75**

WESTON MICROAMMETER

WESTON 0-20 microammeter. 54mv scale 0-20. Model 301. Brand new!..... $4.50

RA-58-A HI-VOLTAGE POWER SUPPLY

Ideal for breakdown insulation testing, or as a source of power for a pulse transmitter. This unit supplies continuously variable voltages between 500 and 15,000 volts DC at 35 ma. A voltage Doubler circuit using two 705A rectifiers and two 1 mf condensers is employed. RMS ripple voltage at maximum power is 6%. THIS UNIT OPERATES FROM 115 v/60c. Variable voltage is obtained by means of a Variac in the primary circuit of the high voltage transformer. Size is 21" x 17½" x 29" deep. Net weight 314 lbs. This unit sells for the low price of **$116**

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Visors for 5 inch 'scopes..... $0.75

Broadcast band push-button tuning units inductive, capacitive types..... 2.98

Swinging choke: 2.5 Hy @ 375 ma; 10 hy @ 75 ma @..... 3.95

Tube shields for 2AP1 (and others of the same size) 1.25

Transmitting key; 200 watt..... .79

Matched pair precision resistors 6.33 megs. 3.00

Antenna loading coil, heavy duty with six (6) variable taps, 6¾" x 4¾" dia..... 2.95

52 ohm co-ax types, RG-8/U, RG-9/U, RG-38/U @ .05 per ft. minimum order. 1.50

HANDSETS—WHILE THEY LAST! Famous TS 13 push-to-talk handset with 50-ohm mike and 200-ohm phone. 1 each PL-55 and PL-68. Selling brand new for.. **$5.95**

Hook-up wire, stranded, 100 ft..... $0.95

Mycalex strips ¼" x ⅝" x 14½". Each.. .10

12 for $1.00. Minimum order..... 60

MICRO WAVE EQUIPMENT

MAGNETRONS! Westinghouse type 2J32 (JAN) just released. This is the first large lot of MAGNETRONS to flow into the civilian market! The 2J32 is designed for 10 cm. operation. Brand new, packed in individual protective cartons. The 2J32 is listed at $200. OUR PRICE **$25.50**

3J31's just received. One cm magnetron. Listed at $95.00. OUR PRICE..... **$20**

KLYSTRON Oscillator Tubes 2K25/723-ab, designed for 3cm. operation. New. Packed individually. Listed at $38.00. OUR PRICE..... **$7.75**

1B24 T-R tube..... $ 2.95

Duplexer using 1B24 (3 cm)..... 10.00

30 mc Oscillator-amplifier with 2 6AC7's. Uses 723a/b. Waveguide input, 1N21 xtal detector. With 6AC7's..... $10

With 6AC7's and 723a/b..... $16.50

Thermistor Beads. D-170396, for use with UHF and Micro-Wave Equipment. List @ $3.00 in separate sealed containers. Each $0.95

3 CM WAVE GUIDE SECTIONS

Silver Plated Directional Couplers with a 20 DB drop with:

A. Straight Wave Guide section 6" long..... @ $3.95

B. 15° bend in wave guide 15" ..... @ 5.90

C. 30° bend in wave guide 10" long..... @ 4.75

D. 90° bend in wave guide 15" long, also 90° bend in coupler ..... @ 6.50

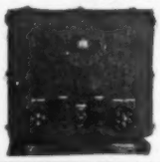
OTHER SECTIONS

E. 2½ ft. section 3-cm wave guide (choke to cover).. $5.95

F. 2½ foot silver plated with 90° bend (2" radius)...@ 5.50

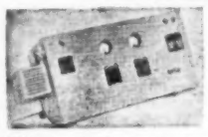
G. 150° bend, with 90° twist 3⅛" radium with pressurizing nipple and coax coupler..... @ 3.95

UNITS AND ASSEMBLIES



NEW POWER SUPPLY for LM-18 freq. meter. Output: 290 v. @ 20 ma; 13 v. @ 600 ma. Input: 105-125 v. @ 60 cps; 260 ma; 27.6 W. type 84 rectifier tube; shock mounted. Complete with input and output cables, tube included **$14.75**

PULSE AMPLIFIER



Signal Corps type **BC400**. Designed for 115 volts, AC 60 cycles. Component parts worth several times the price of this unit. Slightly used. Following are a few of the items that make up the unit. 1—304TL (Eimac). 3—2 mfd. 4,000 W. V.x-GE Pyranol condensers. 1-3200 volt 150 MA power transformer. 1—Variac 5 amps. General Radio type CU 200. 1—5 volt 20 amp. fil. transformer (for 304 TL). 1—2.5 volt 10 Amp. fil. transformer (5000 volt insulation). 1—1 mfd. 1000 volt GE Pyranol. 1—2 mfd. 1000 volt GE Pyranol **$59.50**

NEW USN NAVY MODEL RAK-7 SHIP RECEIVER

15 kc to 600 kc. 6-tube receiver with: AVC-Band pass filter-Audio filter—Noise ilmiter—Precision tuning with a Vernier dial—Voltage regulated power supply, with three tubes, for 60 cycle, 115 volts. Can be battery operated. Complete with spare parts box weighing 73 lbs., spare tubes and inst. book **$69.95**

B-29 Computer Amplifier, containing 8-JAN6SN7 amplifier tubes, 1—6X5 GT, 8—relays, 5—neon glow lamps, completely wired amplifier circuit with many components. This fine amplifier was designed for use with remote-controlled guns. This buy sells for..... **$14.75**

Low Voltage Power Supply for AN/APS-10, using 3-6x5 GT's, and 1—9006, complete with 6 chokes, 1 power transformer, and filter condensers..... **$6.50**

All merchandise guaranteed. Mail orders promptly filled. All prices F.O.B. New York City. Send Money Order or Check. Shipping charges sent C.O.D.

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Tube Type	Approx. List	Your Cost
3BP1	$15.00	$ 3.95
3FP7	27.00	3.35
5BP1	20.00	4.95
5BP4	27.00	5.95
5CP1	45.00	4.95
5CP7	48.00	6.00
5FP4	38.00	4.95
5FP7	32.00	4.25
5JP2	48.00	13.50
837	2.80	1.50
872A	7.50	3.50
705A	22.50	6.75
241B-WE	85.00	50.00
861	155.00	95.00
2C40	....	5.95
2C43	....	8.95

Sockets for 5CP1; 3BP1, and similar types of tubes ..... $ .95

OIL-FILLED CONDENSERS

500	mf	200 vdc	$1.95
2000	mf	50 vdc	2.00
4000	mf	30 vdc	2.25
1	mf	300 vdc	.25
2	mf	300 vdc	.30
4	mf	300 vdc	.35
4	mf	400 vdc	.55
1	mf	600 vdc	.35
2	mf	600 vdc	.40
3	mfd	600 vdc pyr	.65
4	mf	600 vdc pyr	.70
6	mf	600 vdc pyr	.95
10	mf	600 vdc pyr	1.49
15	mf	300 vdc	1.95
1	mf	1000 vdc	.90
2	mf	1000 vdc	1.10
1	mf	1500 vdc	1.20
.4	mf	1500 vdc	.30
2	mf	660 ac/1000 vdc	.95
1	mf	2000 vdc	1.00
2	mf	4000 vdc	5.95
.1-.1	mf	7000 vdc	4.95
.75	mf	20,000 vdc	22.00

G.E. Pyranol 23F47 2mf 4000v. List $30. $5.95

G.E. Pyranol 23F49 1mf-5000v. List $27.. 4.75

C-D TC-50010 1mf 5000v (list $30).. 4.50

G.E. 14F191 .1mf 10000v (list $37). 6.75

G.E. Pyranol .06 mf 15,000 vdc. (list $25).. 5.95

SANGAMO MICA CONDENSERS

F3L .0003 mfd 8000v list $29..... $3.75

F3L .0015 mfd 8000v list $31..... 4.00

Solar type SX .0015 mf 3000v—list $9.95 .75

Sangamo G-4 .004 mf 20kv (list $110) $25.50

Sangamo G-3 .006 mf 10kv (list $87.50) 19.50

TRANSFORMERS

AMERTRAN PLATE TRANSFORMER! 115 v-60 cycle primary. 6200 volt - ct - 700 mil secondary. Size 11" x 14" x 10" **$39.95**

6 HY 700 M.A. CHOKES. Can be used with American Transformers **$7.95**

½ WAVE RECTIFICATION—115v-60c/3200v at 150 mils. MADE BY KENYON..... **$9.95**

Power supply transformer. Pri. 115/60 cps Sec. 1:750v-115a; Sec. 2:6.3v-5a; Sec. 3:5v-3a. 2500TV specially priced at $5.95.

Filament xfmr. 115vac/ 6.3v-5ac.t. 6.3v-5a.c.t. (dual windings) KS-8767..... $2.75

AUDIO TRANSFORMERS

Line to Voice coil transformer. Pri. 600 ohms, Sec. 6 ohms. 1200 Test volt..... $1.75

Audio output transformer Split pri. 1500 ohms each side. Secondary impedance 85 ohms center-tapped—6:1 ratio. 100 Watts output 7.50

Modulation xfmr: typical for 211's CL A/ 50W 1.35

Modulation xfmr: 807 to pr 807's in parallel 1.00

Modulation xfmr: pr. 811's to 813..... 5.00

CHOKES

12 hy-12 hy @ 150 ma., 15 amp rating, each. Price..... $4.25

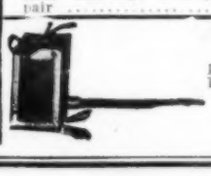
15 hy @ 165 ma 200 ohms DCR, made by Jefferson. Price 2.00

59 hy @ 100 ma 850 ohms DCR, made by Jefferson. Price 2.00

2.6 hy @ 800 ma stud and terminal at bottom. Price 5.00

SELSYN MOTORS

Ideal for remote control, or for antenna rotation. Size 5G Cost per pair **$7.75**



XTAL FILTER

I-F Crystal filter for BC-312, BC-342. Resonant at 470 kc Crystal included **$6.95**

how AMPHENOL eases television's growing pains

A glance at the new Duodecal socket shown below will demonstrate the complete fulfillment of television's demand for a socket of full flexibility and highest quality for the new series Duodecal base television viewing tubes.

This is typical of the pioneering which has established Amphenol leadership in the design and manufacture of TV and FM components.

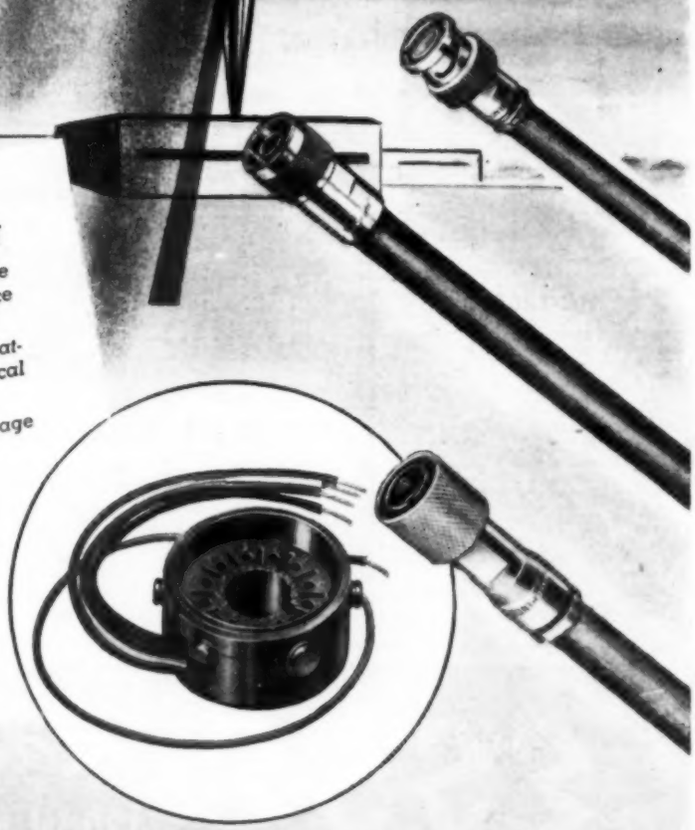
The activity of Amphenol engineers in the higher frequencies enables them to sense in advance the needs in these fields. The new Duodecal socket is but one of many such Amphenol firsts which include efficient Hi-Q tube sockets, octal angle sockets for cathode-ray and other tubes, Twin Lead parallel transmission line, FM and television receiving antennas, solid dielectric coaxial cables, and special-use cables for television color cameras and for facsimile.

Write for Data Sheets on these new products.

AMERICAN PHENOLIC CORPORATION
CHICAGO 50, ILLINOIS

FEATURES OF THE DUODECAL SOCKET

- Six locations for bringing leads out radially in one bundle assure a neat wiring harness, and minimum space requirement.
- Rear socket cap totally encloses connections, eliminating breakage at solder terminals due to flexing. Electrical shock hazard is minimized.
- An extra opening is provided for bringing high-voltage grid lead out separately when this is desirable.
- Latest wrap-around type cadmium-plated phosphor-bronze contacts provide four lines of contact on each tube pin.
- Cap and body of socket are molded black electrical bakelite.
- Spring-ring assembly eliminates screws and drive pins.



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RADIO SERVICE TECHNICIANS

use the BLILEY CCO..

for

instant channel selection

***and* frequency accuracy**

Ask your Bliley Distributor for Bulletin 32

SUPPLIED COMPLETE WITH 7 CRYSTALS, TUBES AND CONCENTRIC OUTPUT CABLE.

The Bliley CCO (crystal controlled oscillator) is the only test instrument available to radio service technicians that features —

DIRECT CRYSTAL CONTROL

— with instant channel selection of the five most commonly used intermediate frequencies — 175 kc, 262 kc, 370 kc, 455 kc, and 465 kc.

— at 200 kc for r-f alignment.

— at 1000 kc for short wave alignment.

Finger tip adjustment is provided by a three position modulation selector and a five step attenuator, with vernier output from 0 to 15 volts. An external socket accommodates extra crystals that may be needed for special requirements.

There is nothing complicated about the Bliley CCO. Simply connect it to the receiver to be tested and select the frequency desired. The crystals are instantly on frequency as soon as the oscillator is energized. It will save you hours of time, eliminate guess work and increase your prestige as a radio service technician.

The CCO is a "techniquality" product of the same engineering skill and craftsmanship that have kept Bliley Crystals foremost in dependability in the frequency control field for over 15 years.

Bliley

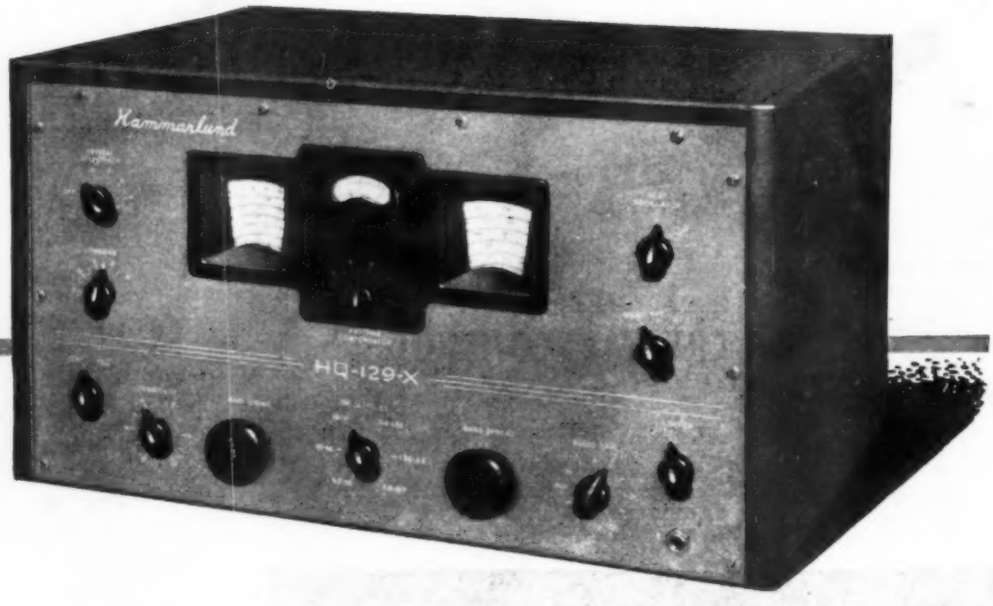
CRYSTAL CONTROLLED OSCILLATOR

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

HQ·129·X

backed by 36 years of know-how

Many thousands of amateurs are using the new HQ-129-X communications receiver. Rarely has a new product been so widely approved in so short a time. The reason is simple—36 years experience and a record of high accomplishment build confidence. The HQ-129-X is an outstanding value from the standpoint of performance and cost.



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MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

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the HQ-129-X
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RADIO CONTROLLED FLIGHT*

The PQ-14, radio controlled AAF plane which provides realistic target for anti-aircraft gunners.

For peace or war, the radio control of airplanes and rockets marks a new era in aviation history.

EDITOR'S NOTE: *Since the recent appearance in* RADIO NEWS *of several articles on the atom bomb test and drone planes, we have received many letters requesting more detailed information on the electronic equipment used to control the drone planes.*

In view of this fact, RADIO NEWS *brings to its readers in this article much of this information. The material contained herein is as detailed as possible under present security regulations.*

AN AMERICAN Army Air Force, technically superior in all phases of air defense or warfare, is a tired world's surest guarantee against the terror of war. Rockets and missiles, controlled by radio, traveling at supersonic speeds and equipped with atomic warheads, shrivel the imagination.

But in August the Army Air Forces revealed that two B-17 Flying Fortresses had flown the Pacific without pilots aboard. Though the news received but slight attention, it pointed the road to future military and civilian aerial activity.

The flight from Hawaii, known as *Operation Remote,* took to the air at Hile and flew 2600 rugged overwater miles before coming down at Muroc Army Air Field, California. The drones were accompanied by mother planes which directed all their flight operations by radio. Throughout the 14 hours and 55 minutes of the record-breaking journey, the mother planes maintained contact with their crewless charges at distances varying from 200 feet to three miles.

Before landing at Muroc, one of the drones dropped a practice smoke bomb off Santa Rosa Island. This involved opening the bomb bays, releasing the bomb and closing the bomb bays, all by remote control.

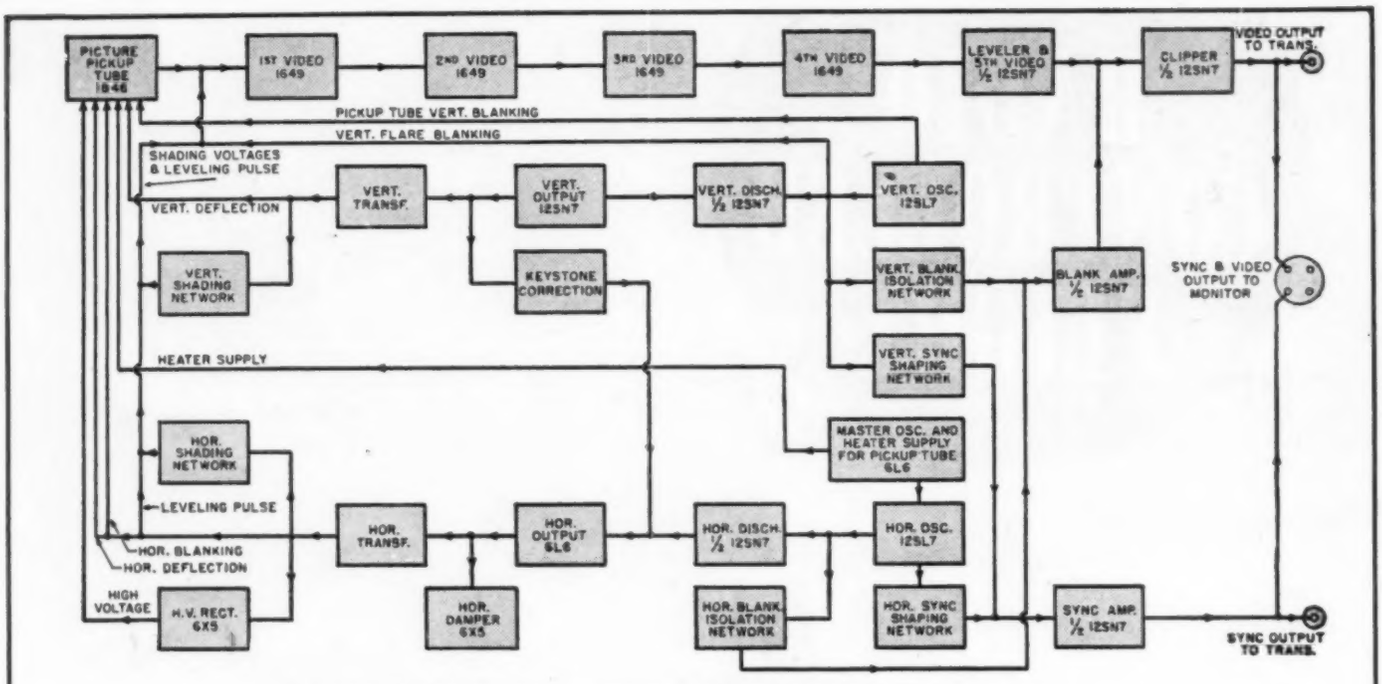
The two drones which spanned the Pacific were veterans of the Bikini atom bomb blast. Together with a number of other AAF drones at Bikini, they gathered invaluable data which will enormously increase scientific understanding of atomic phenomena.

The current drone research program is being pushed with high intensity by Headquarters Army Air Forces through its technical branch, the Air Materiel Command, located at Wright Field, Dayton, Ohio. However, the present activity is just one facet of the total investigation into the application of radio control to flight. It is an integral part of the research program which began with the development of target planes and is currently concerned with guided missiles and completely automatic flight.

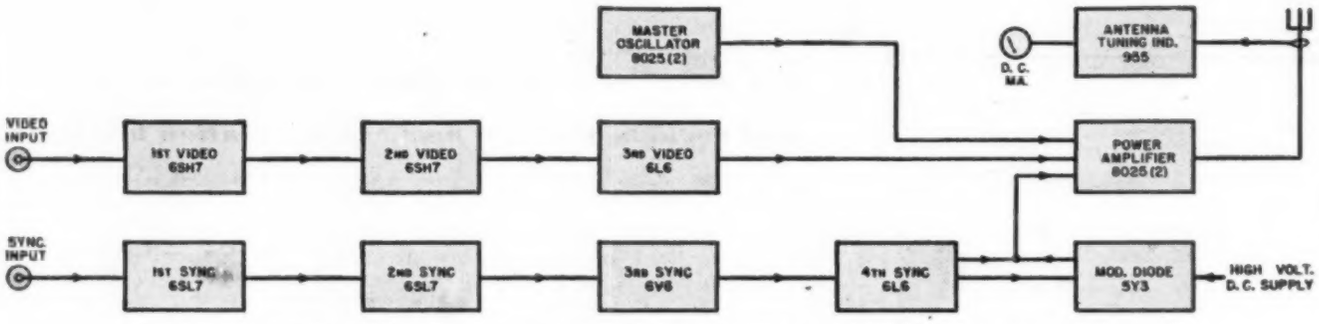
The latest model in the target plane

Radio jeeps, near runway, control take-off and landing of the drone planes. One works the elevators and throttles of the drone while other controls direction.

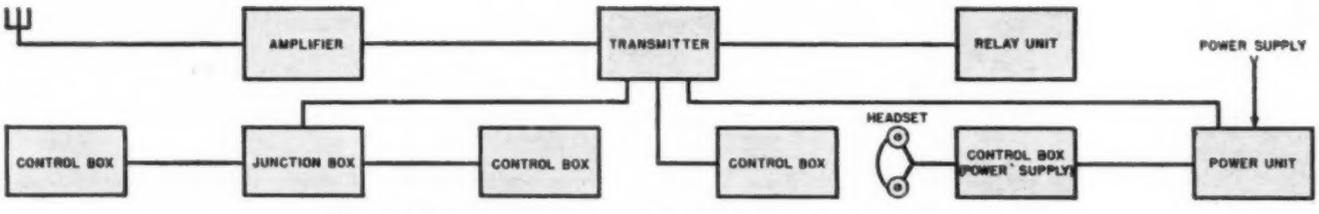
* This article was prepared by the Information and Public Relations Division, Headquarters Army Air Forces, New York, New York.



Functional block diagram of conversion unit PH-522/AXT-2 used in drone plane.

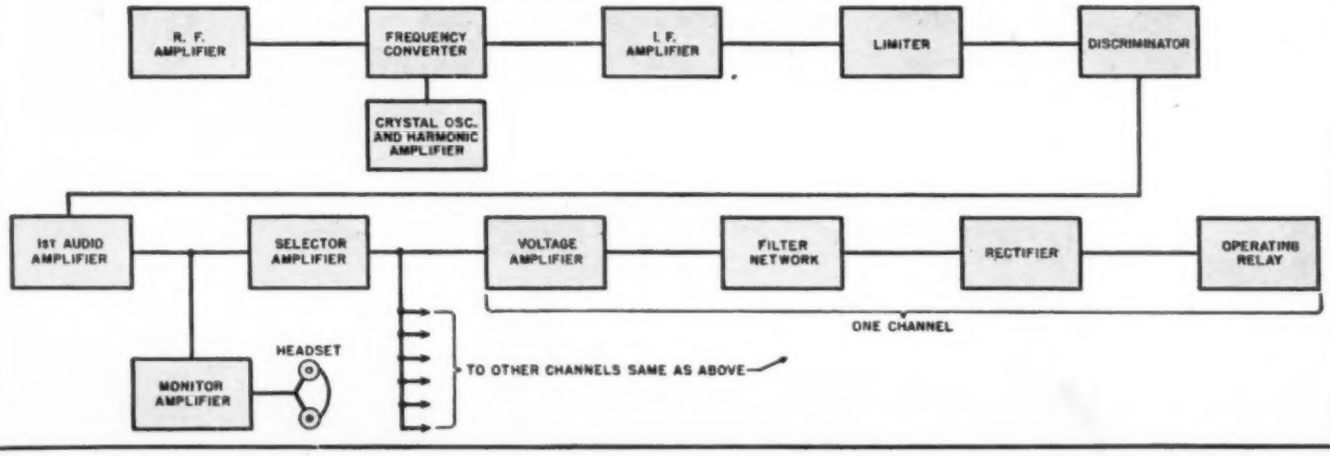


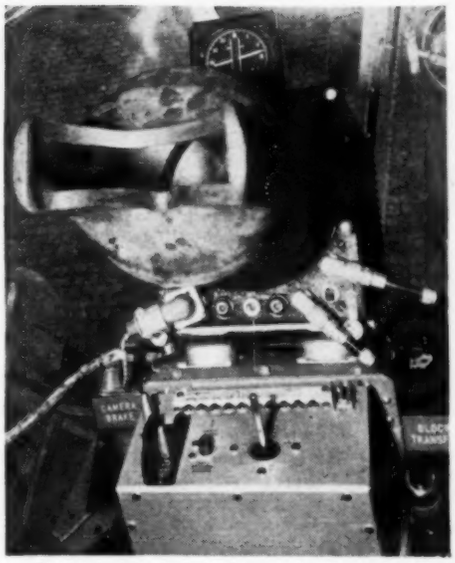
Block diagram illustrates stage-by-stage operation of T-61/AXT-2 transmitter installed in drone airplane.



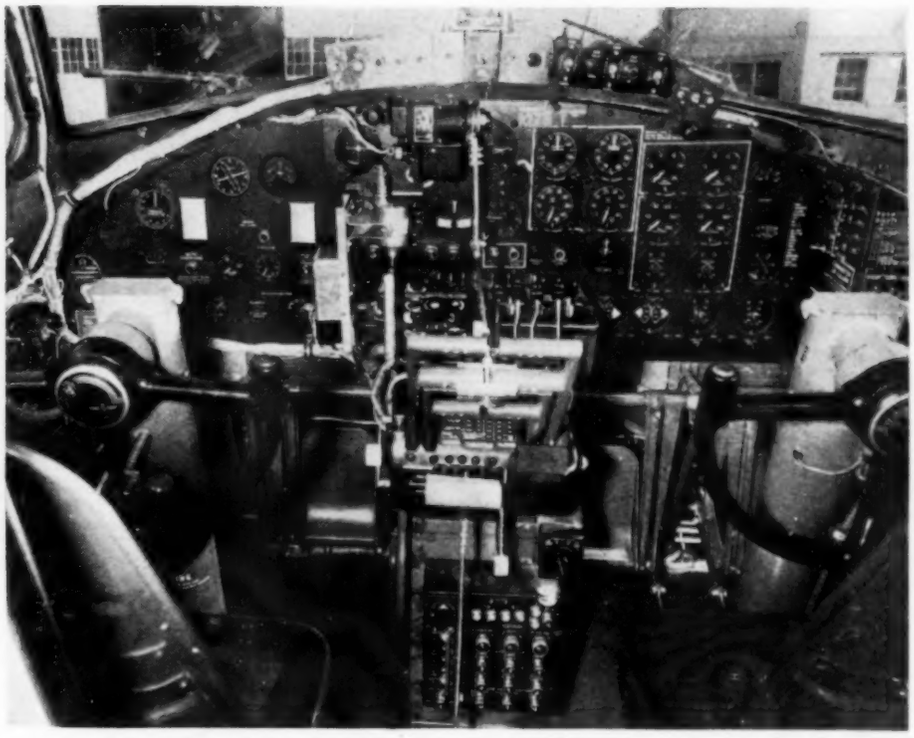
AN/ARW-18 radio control transmitter installed in the "mother" plane.

Radio receiver and selector, AN/ARW-1, installed in the drone aircraft.





The control box which relays "commands" from the "mother" plane to the drone. Above the control box is shown the television scope which allows the pilot to view the instrument panel in the drone being controlled or alternately, permits him to see the area directly in front of the drone plane. This equipment should find wide application in the testing of experimental models of aircraft, thus eliminating the necessity for endangering a test pilot's life.



Full view of the cockpit of the modified Boeing B-17 radio controlled drone aircraft designed for use on the Crossroads Project atomic bomb test. Pilots are excess baggage in B-17 drone. Controls are activated by radio signals emanating from the "mother" plane or the ground control station.

category is the PQ-14. Controlled by radio and maneuvering much as an enemy combat plane would under field conditions, the PQ-14 is a lifelike target which eager marksmen actually can shoot down.

In operation, the PQ-14 is trailed at a safe distance by a mother plane, much as in the *Operation Remote* setup. A pilot sitting in the co-pilot's seat of the mother ship holds a small control box on his lap. Flipping a lever on the upper left hand corner of the box gives the pilot the function he wants. Small lights indicate the number of functions the drone will perform and give the pilot a check on the operation desired.

On the lower right hand side of the control box a small metal "stick," similar to an airplane control stick, is moved to give the horizontal and vertical movements demanded of the PQ-14. Another switch is available on the control box for auxiliary operations.

A frequency-modulated, ten-channel radio receiver relays the "commands" of the mother plane to a gyro-stabilized, remote flight control unit which actuates hydraulic servo motors. This unit corrects the three functions of roll, pitch and yaw, and, in addition, applies the brakes. Through its use, the PQ-14 is enabled to perform maneuvers including 70-degree banks and dives.

Such auxiliary operations as throttle control, retracting and extending of the landing gear, and raising and lowering of the flaps, are accomplished by radio activation of small electric motors which are installed as standard equipment in the target plane. Coordination between the control plane and the target plane is instantaneous.

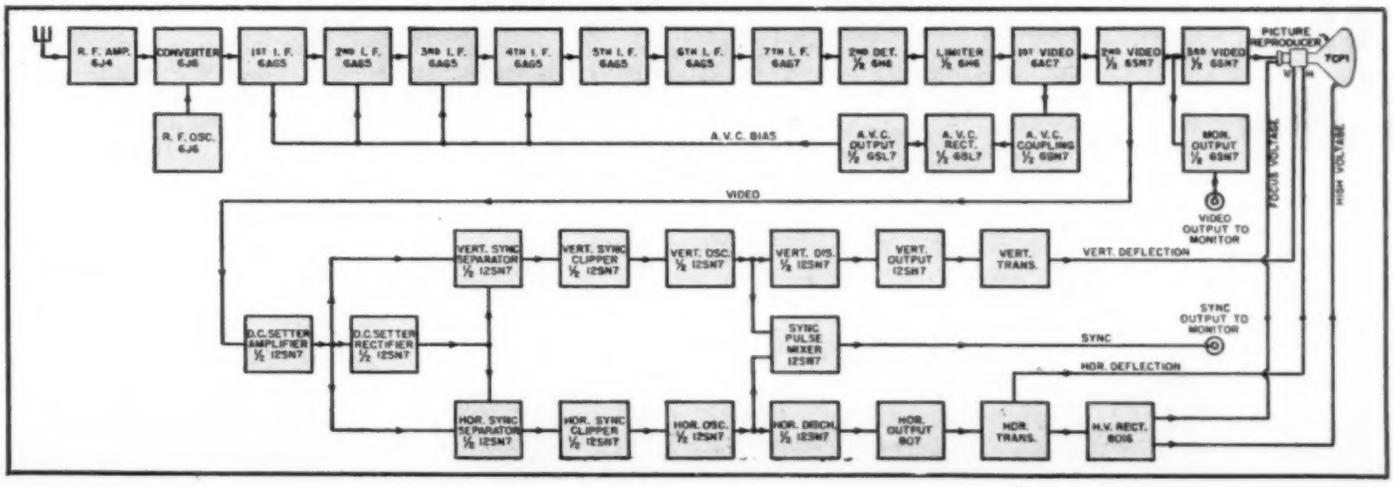
Drones were in operational use during the recent war. War weary B-17s, which had flown full quotas of missions against German installations, were used as guided missiles in a project known as *Operation Castor*. The planes were not outfitted to take off by remote control. A minimum crew took them up and, after the mother plane assumed radio control, parachuted to earth.

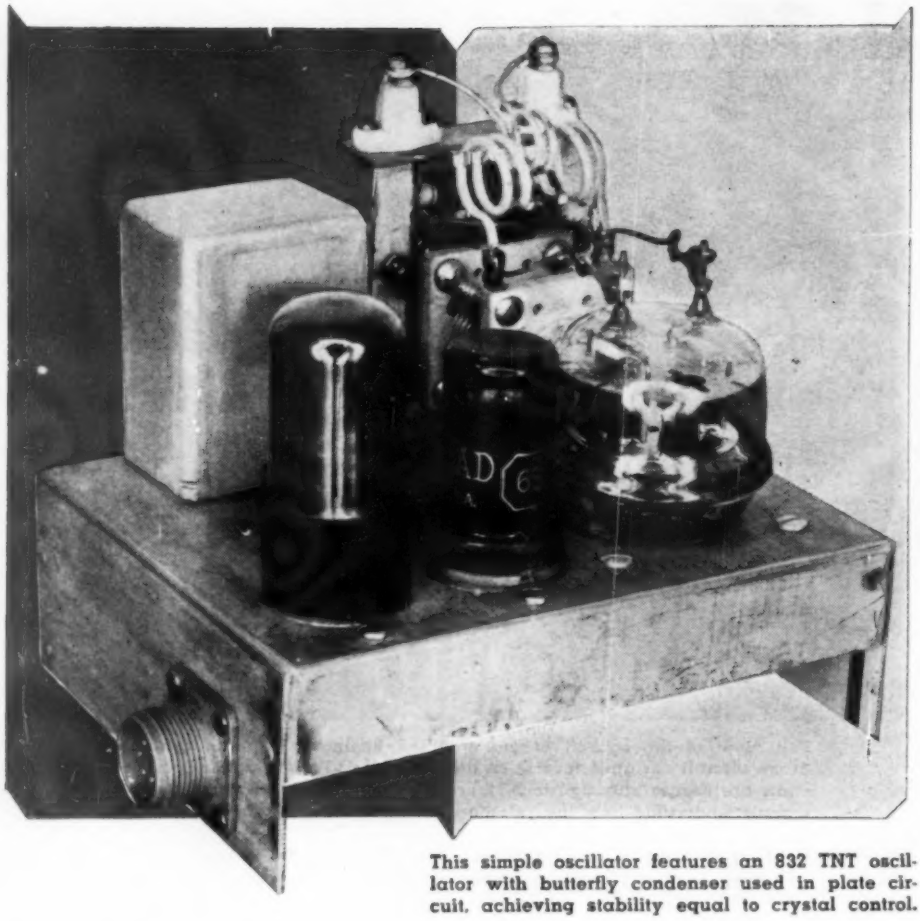
The first Flying Fortress flown in this operation was directed at the submarine pens at Helgoland, Germany, on September 11, 1944. Unfortunately, it was shot down by anti-aircraft fire 1000 feet short of its goal. Another, guided to these same high-priority objectives in October, destroyed 2½ acres of buildings in the target area.

In current usage, such as the trans-Pacific flight, the drone is equipped

(*Continued on page* 137)

Functional block diagram of the R-68/AXR-1 television receiver used in "mother" plane.





This simple oscillator features an 832 TNT oscillator with butterfly condenser used in plate circuit, achieving stability equal to crystal control.

A Stabilized Modulated OSCILLATOR

By ALBERT E. HAYES, Jr., W1HN/3
Consulting Engineer

Presenting a novel method of eliminating the frequency modulation usually attendant in modulated oscillators.

OUR old friend, the modulated oscillator, so popular during the early days of radio telephone transmission, has fallen into disrepute of late because of some of its inherent "bad habits." These "bad habits," or shortcoming, are, in the main, the introduction of spurious and undesired frequency modulation, and the fact that a modulated oscillator can not be modulated 100% without distortion due to the extreme falling off in amplitude on the negative modulation peaks where the anode voltage would approach zero for 100% modulation.

The second-mentioned shortcoming may be avoided by limiting the degree of modulation to 50% or less, as is done in conventional signal generators used by the radio serviceman, and the first-named shortcoming, the attendant and undesired frequency-modulation, is lessened, but not eliminated by this expedient. The elimination of this spurious frequency modulation has been the subject of intensive study by the writer, and a circuit has been developed which enables a conventional radio frequency oscillator to be modulated upwards of 80% in amplitude without any trace of spurious frequency modulation.

The section enclosed within the dotted rectangle "A" in Fig. 1, illustrates a conventional triode tube V_1 connected in a Hartley circuit as is done in many of the signal generators used by the radio serviceman. It is true that other arrangements are often used, but it will become apparent that the Hartley circuit has been chosen for reasons of illustration only, and that the method of stabilization to be described may be applied with equal facility to other oscillator circuits without introducing new factors or considerations.

The parallel resonant circuit L_1C_1, connected in the anode-grid circuit of the triode, is normally considered to be the frequency determining element in such an arrangement. It is known, however, that the condenser C_1 is shunted by several "invisible" capacities, such as, for example, the distributed capacity of the circuit wiring, the grid-plate capacity of the vacuum tube, and *the reactance presented to the resonant circuit by the space current within the tube itself.* This space reactance varies with the amplitude of the applied plate voltage, and it is this reactance which causes frequency modulation of a self-controlled oscillator when an attempt is made to produce an amplitude modulated output signal.

This space reactance causes a change in the effective resonant frequency of the circuit by an amount which is proportional to the percentage of its magnitude compared with the magnitude of the capacity of the condenser C_1. It can be seen, therefore, that the effect of the space reactance may be minimized by the use of a large condenser C_1 so that the space reactance is but a small percentage thereof, and therefore causes a small net change in the resonant frequency of the circuit. This expedient, the use of a "high C" tank circuit, is well-known to all engineers skilled in the design of self-controlled oscillators, and has been used in most signal generators where stability of frequency is of paramount importance. The use of a "high C" tank circuit, however, lowers the over-all efficiency of the oscillator and increases the tank circuit losses. Further, this does not completely prevent frequency modulation, but merely minimizes it. The addition of the reactance tube circuit in Fig. 1 illustrates an arrangement for an amplitude modulated oscillator which completely eliminates frequency modulation and still permits complete flexibility of tuning of the oscillator proper.

A modulation transformer is connected in the plate supply circuit of the oscillator tube V_1 in the conventional manner, and the plate of the modulator tube V_2 is connected to the primary of the transformer. A reactance tube frequency modulator is connected between the plate of the oscillator tube and ground in the manner well known in the frequency modulation and automatic frequency control fields. The control grid of the reactance tube is connected to the output of the modulator tube V_2 through a gain control potentiometer R_1, a reversing switch S_1, an audio interstage transformer T_1, and a condenser C_2.

In operation, the frequency modulation attendant on the amplitude modulation produced by the tube V_2 is cancelled or "bucked" by an opposing fre-

quency modulation produced by the reactance tube V_3. The amount of frequency modulation produced by the reactance tube may be made equal to the spurious frequency modulation by adjustment of the setting of the potentiometer R_1, and may be made to either aid or oppose the spurious frequency modulation by proper setting of the reversing switch. The setting of the switch must be determined by experiment, for the reactive changes introduced by the amplitude modulation of the anode circuit of the oscillator tube may be either capacitive or inductive, depending upon the mode of operation of the particular oscillator circuit used. By experiment it is possible, therefore, to set both the reversing switch and the potentiometer so that there are no frequency modulated components present in the output of the modulated oscillator.

If the oscillator is being used as a signal generator to align or calibrate a receiver, the potentiometer and the reversing switch may be set by adjusting for the minimum "width" of the generated signal on the tuning or aligning control of the receiver under test. This position may be determined very rapidly when the user has become accustomed to the "feel" of the controls. The use of a cathode-ray oscillograph to set the controls is, of course, the quickest and simplest method.

In addition to its use in stabilizing signal generators, test oscillators, and the like, the above-described scheme has proved very worthwhile in reducing the bandwidth of the 144 mc. amateur transmitter at W1IIN. All stations worked report that our signal is as sharp as the best of the crystal-controlled transmitters.

Referring now to Fig. 2, it will be seen that a push-pull TNT oscillator using an 832 dual beam tetrode, is connected in the conventional manner to a 6V6 modulator through a conventional modulation transformer T_1. The 6V6 modulator is driven in the normal manner by a carbon microphone through a microphone transformer T_2. The reactance tube frequency modulator comprising a 6SJ7 pentode, is coupled to the untuned grid coil assembly L_4, L_6 by means of a third winding, L_5, connected between the two halves of the grid coil. Coils L_4 and L_6 are each wound on a form one quarter inch in diameter and consist of 3 turns each of #14 tinned, spaced about the diameter of the wire. The spacing between turns is adjusted to provide feed-back at the desired output frequency. The coil L_5 comprises 10 turns of fine wire one quarter inch i.d. wound on a polystyrene rod which is supported by the coils L_4 and L_6. L_1 and L_3 each consist of 2 turns of No. 10 wire ½" inside diameter with spacing the diameter of the wire, and ½" between coils. L_2 is 2 turns of the same size, mounted between L_1 and L_3. The values of the various circuit components associated with the 6SJ7 reactance tube, were determined experimentally and may have to be changed if widely different

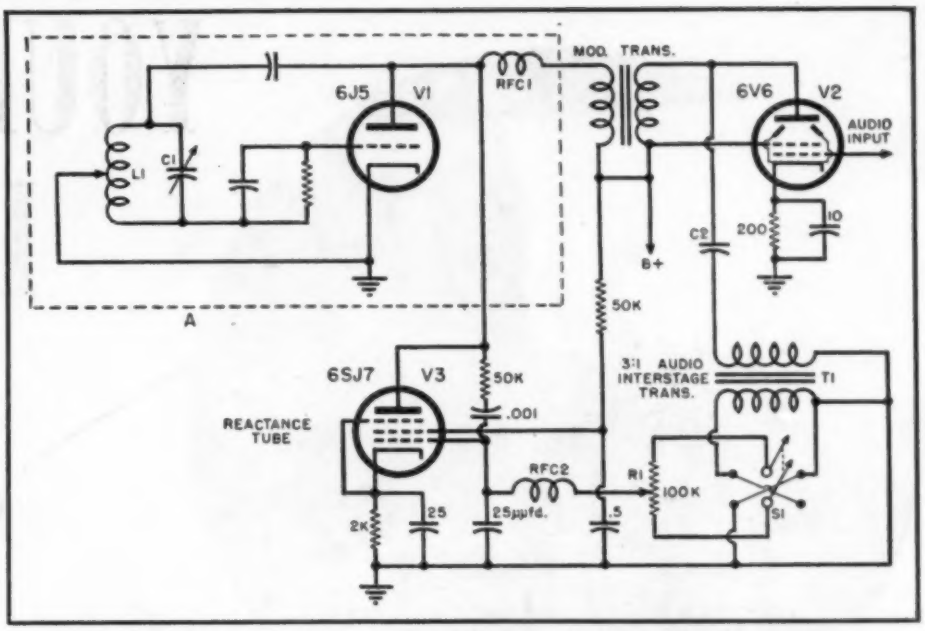


Fig. 1. Schematic diagram of stabilized modulated oscillator. Section enclosed within dotted lines is conventional Hartley oscillator circuit.

lay-outs of components are used. The values indicated in the circuit diagram, however, will probably be satisfactory in most instances.

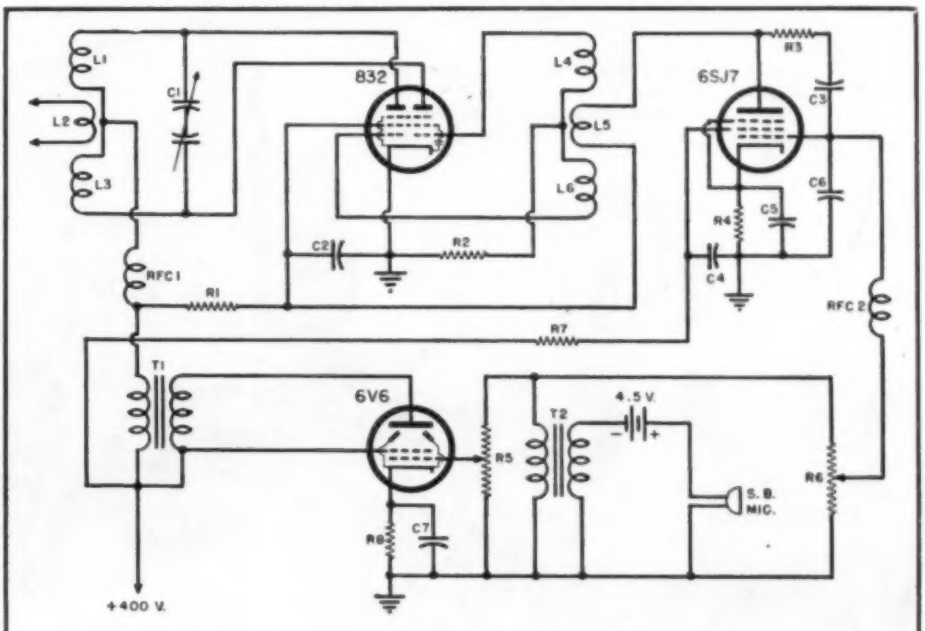
It can not be over-emphasized that the extremely high operating frequency of the system shown, introduces problems of reactance tube design not met with in conventional arrangements.

The gain control R_6 connected in the grid circuit of the 6SJ7, is used to adjust the "counter deviation" until it exactly matches the deviation caused incidentally by the 6V6 amplitude modulator. This gain control R_6 will probably have to be readjusted with changes in the setting of the audio gain control R_5.

The remainder of the circuit is conventional in all respects and the values indicated in the parts list will be found to be generally satisfactory.

The writer wishes to express his appreciation to Mr. R. C. Merryman, W3FBB, for his invaluable assistance in the construction and testing of the model illustrated. —30—

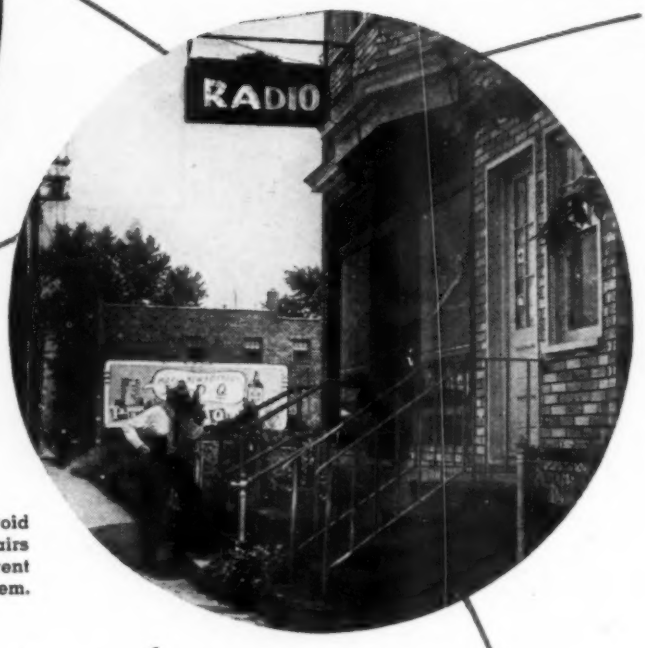
Fig. 2. Schematic diagram of a practical transmitter which incorporates a stabilized modulated oscillator replacing conventional crystal control.



R_1—25,000 ohm, 2 w. res.
R_2—10,000 ohm, 1 w. res.
R_3—200,000 ohm, ½ w. res.
R_4—200 ohm, 1 w. res.
R_5, R_6—1 megohm pot.
R_7—100,000 ohm, 1 w. res.
R_8—200 ohm, 10 w. res.
C_1—20 μμfd. (per sec.) var. cond.
C_2, C_3—.001 μfd., mica cond.
C_4—.01 μfd., 400 v. cond.
C_5—1 μfd., 200 v. cond.
C_6—50 μμfd., mica cond.
C_7—20 μfd., 25 v. elec. cond.
T_1—Mod. trans., 8500 ohm pri. to 6600 ohm sec.
T_2—Single button microphone-to-grid
L_1, L_2 L_3, L_4, L_5 L_6—See text
RFC_1—2-2.5 mh. r.f. choke
1—6SJ7 tube
1—832 tube
1—6V6 tube

YOUR SHOP LOCATION

This is an ideal location for a store from the standpoint of pedestrian and car borne traffic. A more spectacular store front, improved lighting and the use of signs could increase sales.



In selecting the location for your store avoid premises where the customer must climb stairs or step down. This factor is a great deterrent to business, inconsequential though it may seem.

A transfer point is a good selling location, particularly for "impulse items." To make this a good service location, pickup and delivery of the radios to be repaired must be provided.

Avoid dead-end streets in residential areas unless you are a dynamic merchandiser and can overcome the many obstacles which this type of location will put in the way of your success.

The author discusses several important factors which must be taken into consideration when you select the new location for your radio business.

By SAMUEL C. MILBOURNE

LET us suppose, for a minute, that you are either going to open a radio service business or are going to move your existing shop to another location. By what signs can you recognize the "perfect" site for *your* shop? How can you be sure to choose the *most profitable* location?

First, let us understand that—as in many other things—what is one man's jewel becomes another man's millstone. If, for instance, you were to engage in a "wholesale" repair business, that is, do work exclusively for other radio dealers and servicemen, there would be absolutely no need for a "fancy" store front on or near a main street. A loft, or other cheap but commodious floor space, centrally located with respect to your dealers would be your answer.

Second, if you do not do sufficient radio service work to support even a small store on a side street, your logical step is to do your radio service work in the basement or in a spare room of your home until you can build up a clientele. Many servicemen make a satisfactory living operating from their homes, and with a minimum of expense.

However, there comes a time when space becomes cramped, business becomes greater, and more advantageous quarters become a necessity.

The proper operation of a store involves certain responsibilities that will take a definite part of your time which, heretofore, may have been spent solely on radio servicing. The store must be kept neat, the windows must be dressed periodically, there must be someone in the store during the *complete* business day (even when you go out on a call), and there will be a constant flow of floor traffic (for that is the purpose of a store) which will interrupt your actual bench work. If you can not handle these problems, don't open a shop.

Let us assume that the above conditions have been met and that you are going to sally forth in quest of a shop location. How do you go about it?

First, you must be familiar with your town or city. You should know its busy streets and its byways. This should be no problem to a wide-awake radio serviceman who specializes in serving his city. On your calls, keep your eyes open for empty stores. Copy the real estate agent's name and address and, in each case, inquire from him as to the rent and facilities of the site. By all means do not take the first or second store which you see. If you do, you will almost surely get less than you really want and should have. First get a solid basis and understanding for comparing store values *in your town*. Compare such items as (1) rent, (2) floor size, (3) type and condition of building, (4) type and condition of store front and windows, (5) shape and condition of interior, (6) location and condition of any store fixtures, and (7) the approximate cost of fixing it up for your use.

If you are operating in a large city, and you are to confine yourself to one neighborhood, give due consideration to the location of your new shop as it relates to the district you wish to serve, that is, try to locate near the center of your customer area.

Keep a list of these store locations as they come up, and you will soon see at least one case where almost identical stores (as far as store values which we have so far given) will have a variation in rent between them as much as 300% to 500%. While there is always the chance of a "bargain," store values are like everything else —you get only what you pay for. It is the smart serviceman who can size up a store location and can see additional points of superiority which make that *particular* spot more advantageous to him than to some one else in another line of business.

Here are some of the things to look for in choosing a store for your radio business.

1. Proximity to other stores, particularly drug, grocery, meat, delicatessen, frozen food, hardware and department stores; banks, public buildings, and other service institutions; gas, electric, water and telephone offices where people pay their bills; restaurants, theaters, lunchrooms, soda fountains and stationery stores; businesses where the customer delivers and picks up his own things —such as self-service laundries, dry cleaners, etc.; chain stores of any type; professional men's and women's establishments such as doctors', dentists' and lawyers' offices, and beauty shops; business establishments such as manufacturing plants which employ large numbers of people.

Note that in each of the above cases, these types of businesses mean a flow of street traffic. It is your object to obtain a location which will catch the maximum amount of this traffic, either (1) passing your shop, (2) across the street from it, or (3) just around the corner from it. The preference of location is in the order just named.

If you are interested in auto-radio repairs, note the proximity of auto dealers, garages, parking lots and auto supply stores.

Another point to consider in auto radio servicing is to plan for sufficient space so that cars can be driven under a roof for ease of servicing and for the customer's comfort.

If you are interested in the farm trade, watch for feed and grain stores, seed stores, farm implement stores and for stores selling farm-size deep freezers.

If you were checking locations for a large chain company, among other things you would do would be to actually count the flow of traffic past the site. You might find that the early morning traffic was made up of office and factory workers on the way to work, but that these same people homeward bound in the aftternoon used the other side of the street because it was the shady side. People going to work have little time for shopping. Locate on the side of the street where workers walk, homeward bound.

A knowledge of the *type* of people making up the traffic flow is important. For instance, if you want to sell records, a large percentage of popular records are sold to the "teenagers." Thus, if you locate in the "path" of a school, public library or "Sugar Bowl," you are sure to get the teen-age traffic past your store.

Another point to check is whether or not the store is close to a stop on a street car, bus or subway line. People have to wait for such transportation and while they wait, they 'scan" the neighboring store windows and signs. Being close to such a stop is important if your window display or sign is close enough to be seen clearly.

If the stop is a "transfer" point on a car or bus line, or an express stop on a subway, it is an even better location. Once more, such conditions encourage pedestrian traffic and the more flows past your shop, the more chance there is for repair sales. Remember, however, that the better the location, the higher the rent, and that radio repairs alone will not produce top store rents.

A word about store entrances with relation to attracting customers. Most stores have their floors on a level with the street. However, every now and then, you will run across a store with a step or steps in front. The store floor level will be above or below the street level. My personal recommendation is to steer clear of *all* "off-street-level" stores, no matter how "cheap" the rent might be. People just will not walk up or down steps if they can help it—but they will climb down rather than up. Many a small business venture has been tripped by just one step.

There are certain specialty repair services which require special locations. For instance, if you wish to specialize in airborne electronic equipment repair, you should locate at an airport or airfield. Likewise, if

(*Continued on page* 132)

A Breadboard 2 Meter Kilowatt TRANSMITTER

By
G. H. FLOYD, W2RYT
and
H. D. WELLS, W8LWD
Tube Div., General Electric Co.

This experimental 2-meter rig, using new h.f. triodes, can be built at relatively low cost by the amateur.

Operator is shown checking r.f. performance of transmitter. Note that the antenna in this construction is coupled directly to the tank circuit. A regular open-wire, or coaxial transmission line may be used should a remotely placed antenna be desired.

IS THERE some simple and inexpensive way to get on 2 meters? The question assumes importance when one considers how many of us there are who are "planning to go on 2 meters sometimes," but who never quite achieve this end. It is usually not possible to wind a few new coils for your present rig, stick up another piece of wire as an antenna and go on any of the high-frequency bands.

Here, however, is a simple and inexpensive way to get on 2-meters—a bread-board 2-meter kilowatt.

The desirability of a simple rig immediately ruled out both a crystal-controlled or an m.o.p.a. transmitter. This leaves only a modulated oscillator. The authors, although they agree that a modulated oscillator is not too desirable, believe that it is better to be on a band with a properly adjusted modulated oscillator than not to be on at all.

The question of what type of modulated oscillator to use provoked much thought. From the standpoint of efficiency a resonant-line oscillator is to be preferred because a high impedance circuit and a relatively high-Q tank circuit can be achieved. Further, these circuits have large physical size in proportion to the wavelength. Because it offered so many advantages the so-called "teeter-totter" high-frequency oscillator circuit was finally selected. This circuit has the advantage over most resonant-line circuits in that two tubes are used, thus giving a completely balanced layout and eliminating the shorting capacitors which would be necessary, as well as the short circuits present, if a one-tube resonant-line oscillator circuit were used.

Reference to the circuit diagram shows two triodes placed at opposite ends of a foreshortened, 300-ohm, half-wavelength line. The filaments are isolated from ground by radio frequency chokes and the addition of a plate choke and grid resistor completes the circuit.

One advantage of the "teeter-totter" oscillator circuit is that there is no feedback adjustment to make as the grid and plate voltages are automatically maintained 180 degrees out-of-phase due to the location of the tubes on the transmission line. Another important advantage is that the ground circuit is not tricky. There are actually three points in the circuit at r.f. ground; the center of the plate and grid lines, and the r.f. electrical center of the filament circuit. There is no difficulty with length of leads in ground circuits and if it is found to be necessary to connect to ground the connection should be made at the "B minus" point.

In order to obtain optimum results with a "teeter-totter" circuit it is necessary to use high-frequency tubes. The new *General Electric* GL-592 seems to fill the bill very nicely. Although at first glance it might seem strange that a tube of this power capability was selected, it worked in quite nicely with the authors' plans to use the power supply and modulator from the present rigs. A pair of GL-592 tubes was found to be capable of handling an input of 1 kilowatt for 2-meter phone work. Although the pres-

ent rating of the tube is a top frequency limit of only 110 megacycles for full output, tests are now in process to determine how high in frequency the limit may be extended. It is necessary with the GL-592 to use a slight amount of air cooling which is easily provided by a small 10-inch fan. The fan should be placed at an angle to the unit so that air is directed at both tubes.

Constructional Details

The circuit is so simple that the majority of the details can be seen from the photograph. It is extremely important to maintain mechanical symmetry. This was even carried to the point of using two identical filament transformers. This is perhaps carrying the symmetry idea too far but a ten-volt, ten-ampere filament transformer was a little difficult to find so two ten-volt, five-ampere transformers were used.

For purposes of support the tubes are mounted with the anode caps down. The anode support proper consists of two thirty-ampere fuse clips placed back to back with a one inch angle held between them by means of a machine screw. One of the fuse clips fastens to the half-inch copper tubing of the plate line and the other grips the anode cap of the GL-592. The other end of the 90 degree angle fastens to a three-inch insulator which supports the entire assembly.

The grid line is supported on the grids of the tubes themselves, connections being made to the grid line by a thirty-ampere fuse clip which is in turn fastened to a Fahnestock clip which clips over the grid lead. Fahnestock clips are similarly used for filament connnections.

Thirty-ampere fuse clips are also used to connect the plate choke to the center of the plate line and to connect the grid resistor to the center of the grid line. A six-inch insulating pillar at the rear of the unit acts as a tie point for the filament and grid return circuits. A three-terminal tie strip is fastened at the top of the insulator. The filament leads and the filament center tap run to this point from the transformer tie strip located between the transformers. The grid resistor connects to the filament center-tap at the tie-point mounted on the six-inch insulator.

Operating Adjustments

The particular unit shown in the pictures oscillated the first time it was tried. Subsequent testing convinced the authors that only an order from the FCC would stop the oscillations. Very few of the parts were found to be critical, but minor adjustments should be made in order to achieve optimum efficiency.

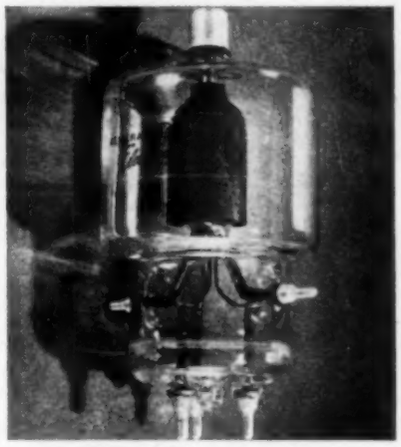
The filament chokes constitute the only part of the circuit that may require any changes at all but the chokes shown in the diagram should work very satisfactorily. The authors found that it was possible to short out the r.f. choke in the plate circuit without any ill effects whatsoever on the operation of the circuit. It was kept in, however, to be on the safe side. The 100-ohm resistor was included in the grid circuit in order to measure the grid current. In use, the grid meter is merely placed in parallel with the 100-ohm resistor. One precaution may be in order at this point. When measuring either grid or plate current do not leave the meters in the circuit any longer than is necessary because the terrific radio-frequency field in the vicinity of this oscillator is liable to burn out the meters. The transmitter and antenna coupling should be adjusted so that the GL-592 tubes draw 0.400 ampere at 2500 volts. The grid current (for both tubes) should not exceed 0.100 ampere but should be kept as high as possible. The grid current ran 0.090 ampere in the unit described, with 2250-ohms resistance in the grid circuit.

Tests showed that the transmitter produced less frequency-modulation when the grid drive was high than when the tubes were not driven hard. For this reason it is recommended that the grid current be kept above 0.080 ampere.

Under normal operating conditions the anode of the GL-592 tube runs a

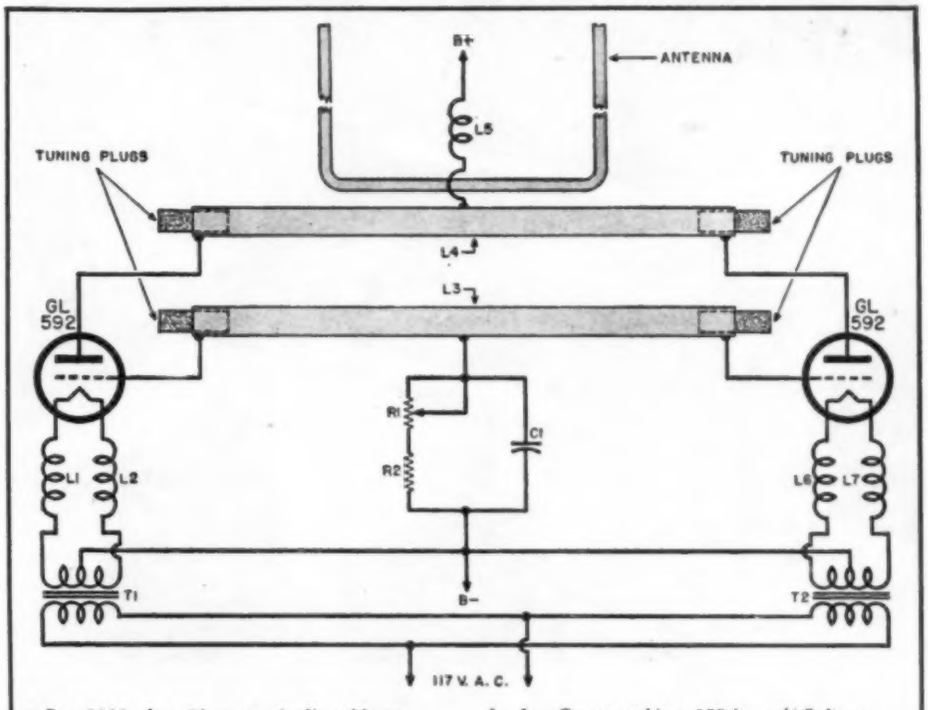
TYPE GL-592
PLIOTRON TRANSMITTING TUBE

This new tube has been designed for use in amateur radio and industrial applications which require power in higher frequency ranges. It is a three-electrode tube designed for use as an amplifier, oscillator, or class B modulator. The anode is capable of dissipating 200 watts for CCS and 300 watts for ICAS conditions. Forced air cooling of the envelope is required. Maximum ratings apply up to 110 mc. For ICAS class C telephony operation, maximum ratings are: d.c. plate voltage, 3000; d.c. grid voltage, −500; d.c. plate current, 250 ma.; d.c. grid current, 100 ma.; plate input, 750 watts; plate dissipation, 225 watts.



Electrical specifications of General Electric's GL-592 tube.

Schematic diagram of 2-meter rig. Two high frequency type GL-592 triodes are used. Although manufacturer's rating for top frequency limit is shown as 110 mc., the authors were successful in obtaining satisfactory operation of these tubes in 2-meter band (144-148 mc.).



R_1—5000 ohm, 50 w., semi-adjustable res.
R_2—100 ohm, 1 w. res.
C_1—.01 μfd., 600 v. mica cond.
L_1, L_2, L_6, L_7—35 T., #14 on ⅜" polystyrene rod, winding length, 4".
L_3, L_4—Copper tubing, 15" long, ½" diam.
L_5—50 T., #20 on ½" bakelite rod, close-wound.
T_1, T_2—Fil. trans., 10 v. @ 5 amps.
2—GL-592 tubes

Fluorescent tube indicates presence of r.f.

bright cherry red. This is a bit unusual for a tube with a carbon anode but the GL-592 has been treated in such a way that no gas is released when the anode is operated at these very high temperatures.

The final circuit adjustment should normally be to test for the presence of r.f. at the center of the grid and plate lines. If there is any r.f. indicated by a neon bulb at these points the fuse clips should be moved one way or the other until the electrical center has been located.

Frequency changing could have been accomplished by shunting the grid and plate of each tube by a disc-type neutralizing capacitor. The authors felt that this would mean needless expense and so decided to use the tuning slugs indicated in the circuit diagram. These tuning slugs are made of copper tubing which is of the proper diameter to give a slide-fit inside the one-half inch diameter grid and plate lines. Each slug is two inches long. If all dimensions are carefully followed it should be possible to tune over the entire 2-meter band by sliding the four tuning slugs in or out of the grid and plate lines. If the frequency is found to be too high with the tuning slugs most of the way out it will be necessary, of course, to make the tuning slugs longer. A change in the antenna coupling will be reflected in a change in oscillator tuning so that it is necessary to readjust the tuning slugs whenever the antenna loading is changed.

Antenna

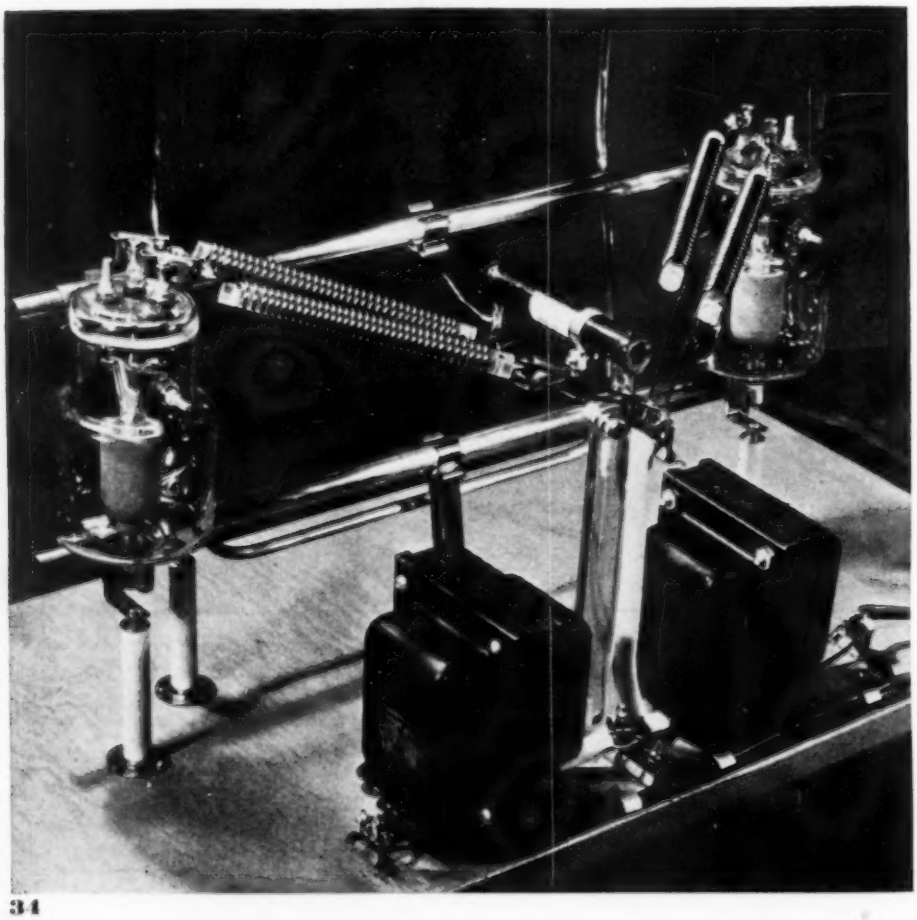
Transmission lines used on the high-frequency bands are sometimes the cause of very strange results. For that reason the decision was made to forego completely a transmission line and to couple the antenna directly to the tank circuit. The antenna shown is a result of this thinking. When it became apparent that it would be necessary to couple over a great percentage of the plate line the authors decided to come straight out from the coupling loop with a pair of half-wave vertical elements spaced ⅛ wavelength apart. The result is an end-fire array with a gain of 4.3 decibels. The pattern of this antenna when checked with a field-strength meter was found to be very close to the theoretical.

The combination antenna, transmission-line and coupling loop is made up from one piece of 3/16-inch diameter copper tubing. The spacing between adjacent half-waves is ten inches, center-to-center. Total height of antenna is 42½ inches. A rod of one-half inch diameter polystyrene, twelve inches long is drilled out to pass the three-sixteenths inch tubing and is then placed on the antenna system twenty-one inches from the top. The rod is required for mechanical strength and adds no loss as it is placed at a voltage node (point of minimum voltage).

The antenna system is supported on two, three-inch insulators, and fastened to them by means of a clamp. Antenna loading may be changed by adjusting the position of the bottom portion of the antenna system with respect to the plate line. As the photograph shows it is necessary to bend the two half-wave lines in order to clear the grid line.

In some cases it may be desirable to use an antenna remote from the transmitter. If this is the case, a regular open-wire or coaxial transmission line may be used. The pickup loop should be coupled to the plate line only. The size of the coupling loop will depend on the loading desired.

Closeup view shows details of complete assembly. Note in particular the mechanical symmetry of the construction. This is important and should be closely followed. The two GL-592 tubes have been mounted with the anode terminals down. This was done in order to provide a mechanical means of supporting the tube.



Results

In a series of tests made with this rig on the air, it was very difficult to tell what effect the beam had as all of the stations contacted were using superregenerative receivers. On one contact, however, an interesting experiment was made. While W6OJK/2 was in contact with W7BBI/2, George asked the op at W7BBI/2 how much hiss was still present in his receiver. When it was learned that there was no hiss present W7BBI/2 was requested to reduce his antenna coupling until some hiss was present in order that a signal strength comparison could be obtained. After much fussing W7BBI/2 came back and said that he was sorry but with the antenna on his receiver decoupled as far as possible, there was still no hiss in his receiver when receiving W6OJK's carrier.

At first thought it might seem that a modulated oscillator with a kilowatt of power might put out an extremely broad signal. This, however, did not seem to be the case and in one direct comparison against another 20-watt carrier the kilowatt carrier covered five divisions on W7BBI's receiver as compared to four divisions for a 20-watt carrier which was being received over approximately the same distance.

—30—

JANUARY, 1947

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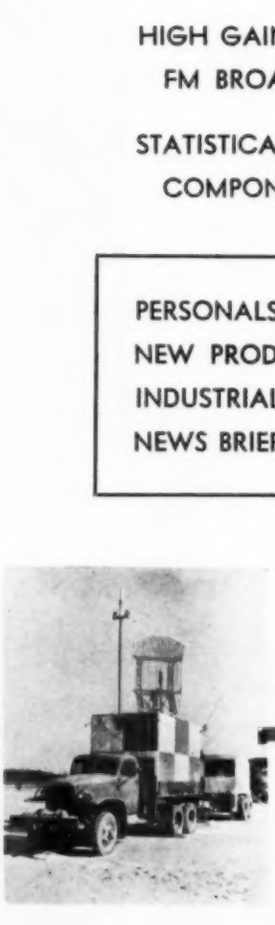

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COVER PHOTO—Courtesy of Bendix Radio

The Bendix airport surveillance system, known as AN/GPN-2. It gives complete radar coverage of the sky within 30 nautical miles, up to more than 10,000 feet, and includes two-way radio communications equipment operable on all aircraft frequencies.

The REPRODUCTION of DISC RECORDINGS

By
JOHN D. GOODELL
The Minnesota Electronics Corp.

A discussion of playback techniques, including stylus design and equalization methods.

Fig. 1. The Aeropoint "88" needle, showing the special type of bent shank to provide increased vertical compliance and lateral stiffness.

LARGE quantities of money, time and effort are spent on the design of fine amplifiers and loudspeaker systems for the reproduction of recorded music. It is unfortunate that in many instances the results fall short because too little attention is paid to events that occur at the point of the needle. Most engineers realize that the characteristics of needle structures play a large part in determining the results obtained from any playback system. Relatively few give sufficient weight to the importance of these factors. This is partly due to the fact that almost no data is available in the literature, and generalized articles rarely emphasize this phase of record reproduction problems. Another factor has been the lack of methods for making valid and rapid comparisons under standardized conditions. The recent publication of the *Clarkstan* sweep frequency transcriptions developed by Wayne R. Johnson, recording engineer, provides a simple means of demonstrating the wide differences in frequency response obtained from various types of needles.

Validity of the response curve from this disc is indicated by Fig. 4 which was obtained by using a Pickering Pickup as a laboratory standard. According to the manufacturers, the recorded signal consisted of a 20-cycle per second sweep from 100 to 10,000 c.p.s. with marker pips as shown in Fig. 4. The only supplementary equipment required is an oscilloscope with an available 20 c.p.s. horizontal sweep frequency. By first observing the response curve directly from the pickup and then connecting the oscilloscope to successive stages of the amplifier, it is possible to make rapid comparisons and investigate the effects obtained through an entire audio channel from needle point to voice coil. On Figs. 6, 7, and 9 a number of indications are shown in addition to frequency response.

A dynamic visual response curve is particularly valuable in determining the effect of tone controls and equalizers. In designing such devices, observing the experimental effects of inserting various component values often involves tedious curve plotting. With this method it is possible to make close approximations very rapidly.

The first post-war year has brought a number of new approaches to pickup design. Some of these were discussed in the preceding article on this subject;[1] others will be described in the third article of the series. The trend is very strongly in the direction of new suspensions, minimum needle pressures, higher compliance of vibrating structures with lower mass, and new applications of energy transduction methods. A high percentage of new designs is intended for use in moderately priced equipment. The initial requirement in accomplishing most of the features outlined above is a small permanent needle structure. Increasingly light needle pressures permit designs including protection against shock and guards into which the needle withdraws if the pickup is dropped. With regard to vertical shock, it is clear that the vertical compliance possible in any design is limited by the demand for needle pressure. With low needle pressures flat or cantilever spring needle supports may be employed so that the shock that may possibly be applied can never exceed the small force necessary to drive the needle inside its guard. This means that a sapphire stylus may be employed with much less danger of fracture and chipping. Typical of these is the design of the *General Electric* needle support shown in Fig. 14. This structure will stand an amazing amount of abuse without damage.

It has been generally assumed that optimum needle point design involved a half sphere of symmetrical dimensions. The cutting needle used for lateral recording produces a groove, the width of which is modulated at harmonics of the signal frequency. This variation in width affects the playback system largely in terms of vertical displacement of the needle, resulting in "pinching" distortion. It is quite possible that current laboratory investigations will determine a new basis for playback stylus tip design that will improve this and other undesirable features of the standard spherical shape. In order to minimize the transmission of frictional "drag," it might be desirable to shape the tip in a manner that would increase its effective mass in the direction of groove travel with respect to its effective lateral inertia. There is room

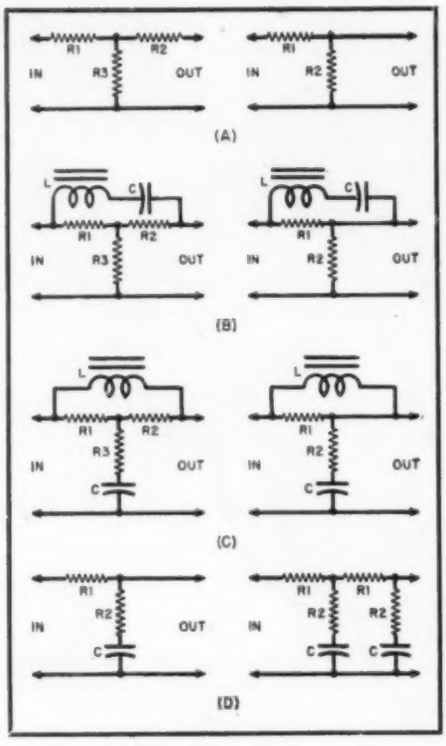


Fig. 2. Equalizer circuits for various responses. Those on left are "T" sections, and on right the corresponding "L" sections. (A) Initial insertion loss of 20 db. (B) Series resonant circuit for producing the needed frequency discrimination. (C) Improvement over (B) with respect to impedance matching. (D) Simple R-C circuits may be used, but rate of rise at crossover point may not be satisfactory. Left diagram is for single "L" section, right for dual section.

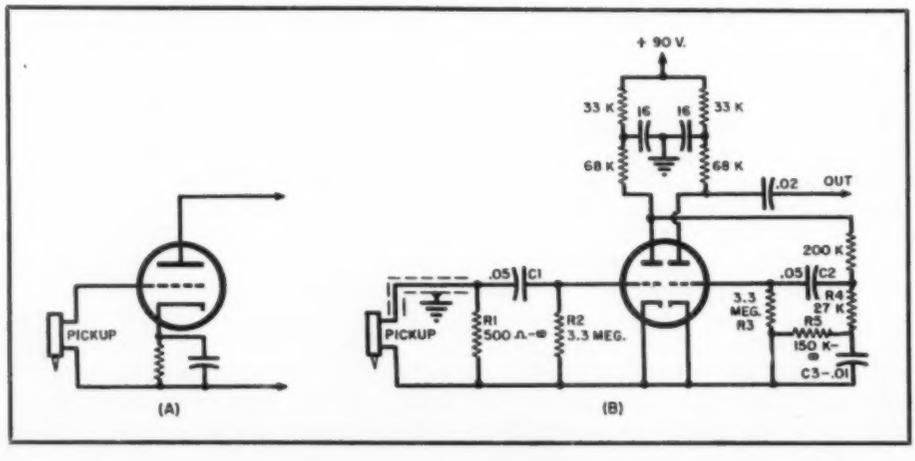
for a great deal of research in this relatively unexplored field.

In the design of replaceable needle types, there has been a great tendency to decrease the stiffness of the shank so as to provide a mechanical low-pass filter. With the advent of wide range records available to the public in abrasion-free materials, this practice becomes particularly undesirable. Frequency discrimination is certainly necessary to produce pleasing results with various types of records, but it should be done with adjustable controls and not permanently limited at the signal source. One method of lowering surface noise and maintaining high frequency response is to use a special type of bent shank needle such as the Aeropoint "88." This needle, shown in Fig. 1, is so shaped that the point is practically vertical to the record surface. The shank of the needle is flattened in such a manner as to provide increased vertical compliance and lateral stiffness. This tends to damp out undesirable vertical response and increase lateral high frequency response. The use of abrasion resistant metal alloy tips minimizes needle wear without the danger of chipping experienced with replaceable sapphire types in relatively heavy needle supports.

It has been emphasized repeatedly that the entire disc recording industry is in a state of confusion regarding the standardization of recording and playback technique. A typical example of this is the wide variety of groove widths and shapes encountered in commercial records. There is an enormous number of variables to be considered. Only a few of the important ones will be mentioned here. It is standard practice to refer to the percentage ratio between groove width and the uncut space between the grooves as a land/groove ratio. If this ratio is held constant, then for a given recording stylus the depth and width of the groove will vary inversely with the number of lines per inch. It is common practice to hold the land/groove ratio constant at 60/40 or 70/30, regardless of the pitch of the grooves. There appears to be no reason for this other than some convenience in rapidly adjusting cutting needle pressures to an arbitrary, but not necessarily desirable, fixed reference. Thus it would appear that this one feeble gesture toward standardization results in still greater complexities. It is a great nuisance to attempt to change playback needles for every variation in lines per inch. In broadcast studios the same pickup and stylus are generally used for playing 133 line transcriptions and 96 line commercial records. Generally speaking, a spherical radius for the stylus point (see Fig. 11) of .002" is approximately correct for most 33⅓ r.p.m. transcriptions, but such a stylus will fit loosely and tend to rattle in a 96 line, 78 r.p.m. recording where .003" would be proper. It would seem wise to consider standardization in terms of spherical radius, included angle and groove shape. This would mean holding the groove depth constant instead of the land/groove ratio. Such a procedure would mean that playback equipment could be equipped with a standard stylus that would be correct for all new recordings, regardless of groove pitch. Of equal importance, the recording engineer could standardize on a basic design for his recording styli that would aid greatly in making his results more consistent. It is probably desirable to effect a compromise in order to provide for the wealth of recorded literature now in existence. It is suggested that recording and playback styli and techniques be standardized in terms of a .0025" stylus radius. This will minimize the high frequency loss obtained from .003" styli as the center of the record is approached and yet will not affect the signal to noise ratio on shellac 96 line recordings too seriously.

All commercial records are made with inherent frequency distortions dictated by necessary compromises. Records intended for broadcast station use have a pre-emphasized signal in the upper and lower ranges to permit playback equalization that decreases the effect of scratch, rumble and other extraneous noises. Discs sold to the public are recorded at constant velocity above a certain frequency, and at constant amplitude in the low range. Most manufacturers now use 500 c.p.s. as the crossover point, but 300 c.p.s. and other frequencies have been used in the past, and there is still no real standardization in the industry. Obviously no pickup can automatically compensate for these widely varying record characteristics. If a magnetic pickup is properly designed, it acts as an essentially perfect generator and has a flat response to a constant velocity recorded signal. The Pickering Pickup is an excellent example. An X-ray rochelle salt crystal pickup may be regarded as a capacitive device and it produces constant output from a constant amplitude signal. Pickups designed on other principles, such as

Fig. 3. (A) Effective open circuit conditions for a magnetic pickup. (B) Suggested preamplifier for the G-E variable reluctance pickup. A type 6SC7 tube may be used; input shield must be grounded only at the preamplifier.



magnetostriction, variable capacitance, resistance, etc., fall essentially into one of these two categories with regard to constant velocity and constant amplitude recorded signals. It is clear that frequency equalization is always necessary to produce proper response characteristics in playing commercial records.

The needle point is the first link in the reproduction chain; the mechanico-electral transducing mechanism of the pickup, the second; and the equalizer, the third. No matter how perfect the first two, the final result is still completely limited by the performance of the equalizer. There are many reasons for the use of tone control devices, and some of the methods described may be used in any application where it is desirable to change the tonal balance.

It is common practice to speak and think in terms of "increasing" the response in a certain portion of the spectrum. Actually, all equalization, directly or indirectly, is accomplished through initial "loss" circuits. Essentially the procedure consists of inserting a resistive (non-frequency discriminating) loss corresponding to the increased response desired at a certain frequency. This resistive circuit is shunted or otherwise modified in such a way as to remove the loss in the frequency range which it is desirable to boost. As an example of this, the basic procedure for equalizing an N.A.B. characteristic for a magnetic type of pickup is given. A rise of approximately 17 db. from 1000 c.p.s. is required. The resistive loss circuit may be an L section if an impedance match is required on one side only, or a T if input and output matching is necessary. In order to provide a slight margin, an initial loss of 20 db. is inserted as shown in Fig. 2A. In a 500 ohm circuit T section, R_1 would be 400 ohms, so also would R_2, and R_3 would equal 100 ohms. Using the L section, R_1 would be 1750 ohms and R_2, 500 ohms.

In order to accomplish the needed frequency discrimination, a series resonant circuit may be employed, as in Fig. 2B. The inductance in this case would be correctly chosen at about 4 henrys and the capacitance about 4 microfarads to provide a slope corresponding closely to the 6 db. per octave record characteristic. A basic disadvantage of this method is the fact that the impedance diminishes to a very low value at resonance. Below resonance the response decreases rapidly.

An improved condition with respect to the desirability of constant impedance matching is obtained by the circuits of Fig. 2C. In a 500 ohm circuit, 4 henrys and 4 microfarads are approximately correct for a 500 c.p.s. turnover.

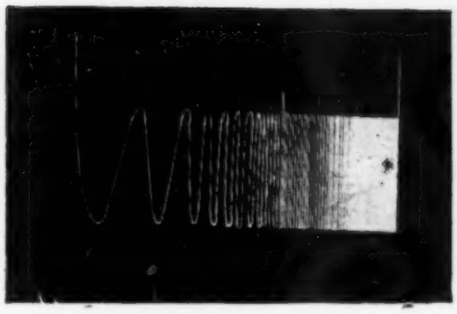


Fig. 4. Perfect reproduction of the Sweep Frequency Transcription, showing marker pulses.

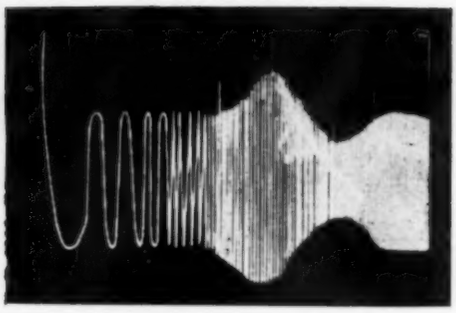


Fig. 5. A peak and a dip in the middle frequencies accompanied by distortion.

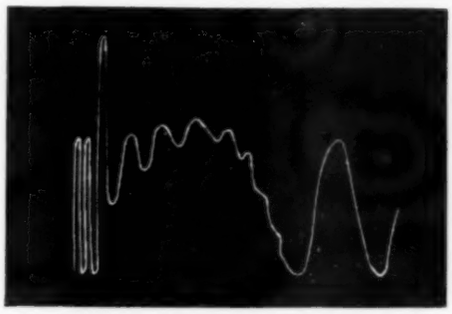


Fig. 6. An expanded sweep showing a portion of the low and high frequency spectrum. Very poor transient response.

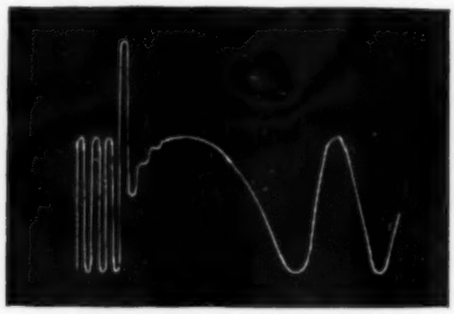


Fig. 7. An expanded sweep showing a portion of the low and high frequency spectrum. Excellent transient response.

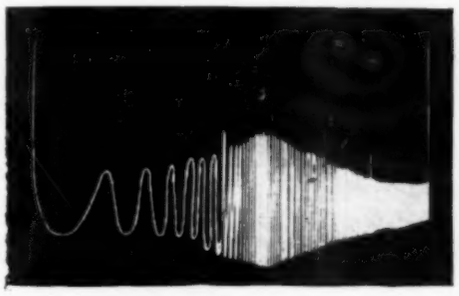


Fig. 8. Low and high frequencies. Both are considerably attenuated.

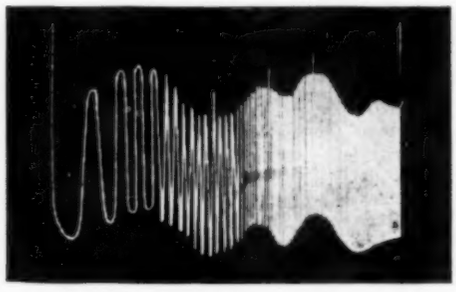


Fig. 9. Flat frequency response with considerable mechanical vibration.

Simple RC circuits indicated in Fig. 2D may be used to obtain reasonably satisfactory results. The greatest difficulty appears at the knee of the curve near the crossover frequency at which point the rate of rise is not adequate. The double section produces a steeper rise at the turnover point and is much more satisfactory. A considerable advantage of these circuits is that they are relatively simple to design with practical values for operation at any impedance level. It is necessary to meet the following requirements for optimum results:

1. $20 \log \frac{R_1+R_2}{R_2}$

should be approximately 6 db. greater than the desired equalization.

2. The impedance of the load must be at least ten times R_2.

3. The capacitive reactance should be equal to

$$\frac{R_2 (R_1 + R_2)}{R_1 - R_2}$$

at the frequency where a 6 db. rise is desired. An inverse RC network may be used in a degenerative feedback loop, and with careful design practically any frequency response characteristics may be obtained.

With most types of magnetic pickups, the high frequency response varies directly with the load across the pickup. The largest resistance possible would be the effectively open circuit conditions of Fig. 3A where the pickup constitutes the grid return. An advantage of this arrangement is the low resistance of most such pickups which places the grid only a few ohms above ground. This makes the grid much less sensitive to induction hum. The circuit suggested as a preamplifier for the General Electric variable reluctance magnetic cartridge is shown in Fig. 3B. R_1 may be any value from 500 ohms to infinity. A value of 1000 ohms provides a drooping upper range characteristics. A better choice is 75,000 ohms or more. R_4 and R_5 with C_3 provide a reasonably satisfactory crossover compen-

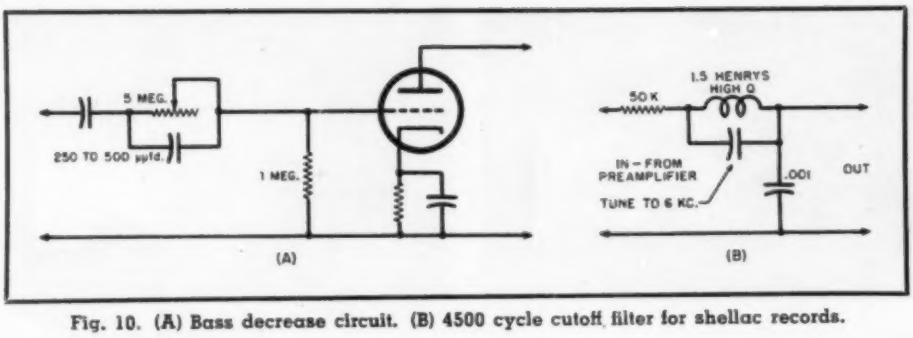


Fig. 10. (A) Bass decrease circuit. (B) 4500 cycle cutoff filter for shellac records.

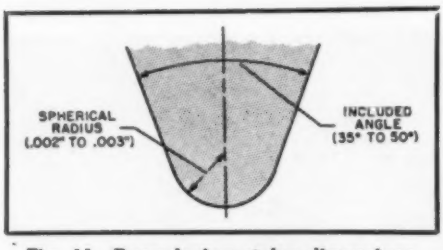


Fig. 11. Reproducing stylus dimensions.

sation for low frequencies. The rate of rise at the knee of the curve is not quite sufficient, and this can be improved by using a two section network as indicated in a preceding paragraph. Where noise-free high quality turntables are used, R_5 is undesirable. In most turntables and in practically all record changers, rumble is a problem and R_5 is useful in minimizing very low frequency response by limiting the maximum effective impedance of C_3. If R_5 is left out, the bass response from most records tends to be excessive. If a low frequency loss control is used to produce flat response under normal signal input, this characteristic may provide an effective low frequency boost in playing records with inadequate bass. Gain from this preamplifier is approximately 35 db. The use of grid current bias with the cathode at ground potential is desirable in avoiding hum caused by heater/cathode differences of potential. It is important that leakage be minimum in the grid blocking capacitors in order to avoid unintended bias voltage developed by small leakage currents through the high grid return resistance.

It is often considered desirable, particularly for home reproduction, to have a rising bass characteristic available. One method is to over-equalize below the crossover frequency as indicated above, and to provide a continuously variable low frequency attenuator. A simple method is shown in Fig. 10A. With a grid resistor of 1 megohm, the potentiometer should be 5 megohms. The capacitor may be 250 to 500 micromicrofarads. The latter value produces a variable slope corresponding closely to a 500 c.p.s. crossover equalization characteristic.

There are two fundamentally different viewpoints on the general subject of equalization and tone control. One school takes the purist view that all effort should be directed toward reproducing the original signal to the record as precisely as possible, or at least reproducing the subjective experience of a listener to live music. The other basic view is that many people prefer various distortions, particularly with respect to limited upper frequency response, to the real thing. This is clouded by philosophical considerations beyond the scope of this article. In developing equipment for home use, it must be recognized that there are at least two basic applications for music reproduction. One is to provide a direct and complete form of intellectual and emotional entertainment. In general, this means the playing of records under circumstances where the entire attention of the listener is intended. Many times this is not the case, and the phonograph is expected simply to provide a quiet background of pleasant sounds. For this purpose most people seem to prefer a somewhat excessive bass response and a treble cut that eliminates the intrusion of distracting highs. If this is true, then variable tone controls are a necessity that cannot be eliminated by improvements toward the perfection of recording and reproducing techniques.

New needle structures, new record materials and new dynamic equalization techniques, such as the H. H. Scott Noise Suppressor, are rapidly reducing background noises of all kinds to a negligible quantity. If the industry is capable of a small amount of coordinated effort toward simple standardization, the millennium is near at hand for a growing section of the public to whom music is important. Of greater importance to most people in the industry, the millennium with regard to profit may also be approached. The combination of these incentives should bring about a satisfactory result. If it does not, there are many potential threats on the horizon in the way of radically different recording methods.

Fig. 12. High frequencies accentuated.

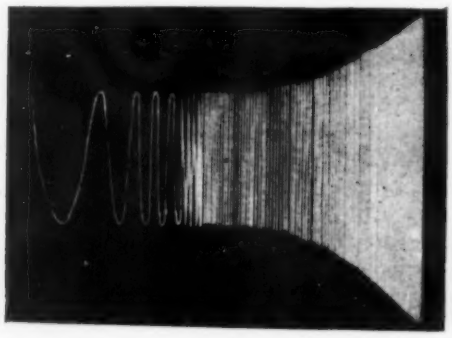
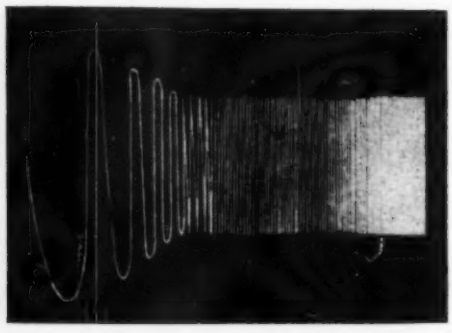


Fig. 13. Low frequencies accentuated.



Note on the Design of Magnetic Pickups

In the preceding article on this subject, a possible inherent advantage of moving coil versus magnetic pickups was mentioned. It was pointed out that in a magnetic pickup it is necessary to provide sufficient restoring force in the form of stiffness for the vibrating system to overcome the natural affinity of the armature for the pole pieces of the magnet. In reaching this conclusion an important phase of the problem was overlooked, and the following clarification is of interest. With the magnet removed from the pole pieces, the stiffness of the armature system in a magnetic pickup may be greater than a corresponding moving coil, but with the pole pieces activated by the magnet, a negative stiffness is produced which may be designed to reduce the effective total stiffness to as low a value as desired. Norman C. Pickering reports having made experimental magnetic pickups where the restoring spring force exactly balanced the pull of the pole pieces and the effective stiffness was reduced to zero. This extreme is too critical for practical application, but actual comparison between existing moving coil and magnetic pickups have shown that the latter may be designed with lower total effective stiffness than is achieved in practice with moving coil designs.

The basic approach to the design of a high quality magnetic pickup is developed from the fact that the instantaneous voltage is

$$E = KN\frac{d\phi}{dt}$$

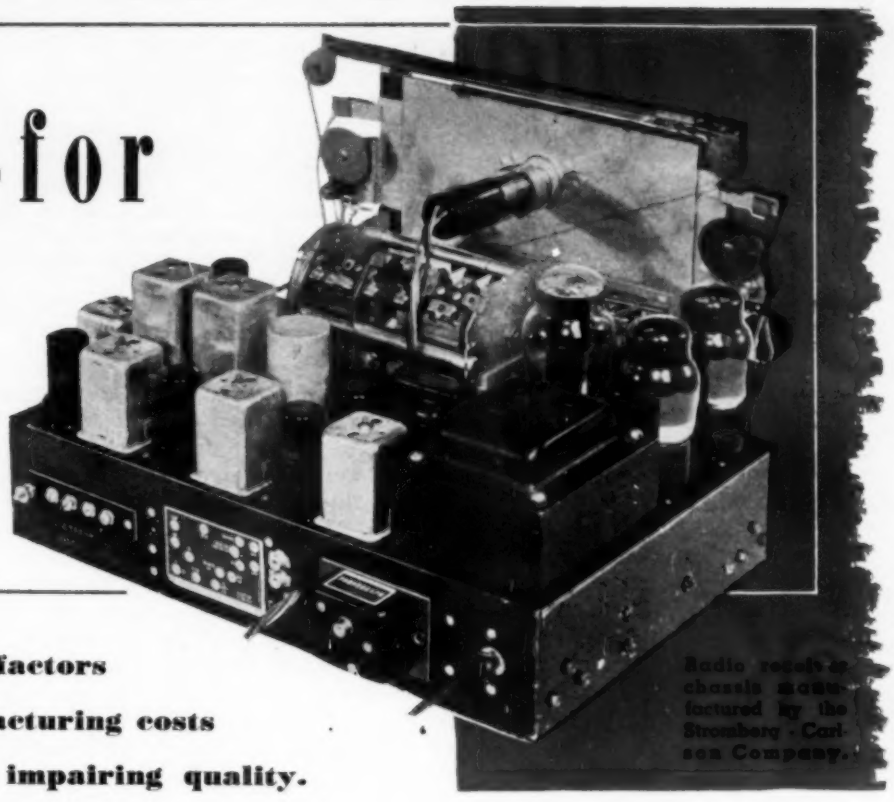
where K is a design constant, N is the

(*Continued on page* 28)

DESIGN-for SAVING

By

A. C. MATTHEWS



Radio receiver chassis manufactured by the Stromberg-Carlson Company.

A discussion of many of the factors involved in reducing manufacturing costs of radio receivers without impairing quality.

THE thought uppermost in the mind of many a radio engineer is that of maintaining a high standard of quality during production. Should the quality be lowered, even temporarily, the prestige and good will of the company for which he works is likely to suffer. He is concerned not only for reasons of professional pride but because it is his duty to his employer. It is imperative then, that quality be maintained *at any cost,* and this is the usual stumbling block because competition makes it necessary to be continually cost conscious. Designing for minimum cost, keeping in mind the maintenance of a high standard of quality, is part of an engineer's work and incidentally an interesting part, since it requires considerable experience and ingenuity to do a worth-while job. In this article the factors involved in the cost of a unit will be discussed with a view toward their minimization.

There are three general items to be considered when analyzing the cost of a product; (1) material, (2) labor, and (3) overhead. These may be subdivided according to the complexity of the product being produced. Since a radio receiver is quite a complex product, there are several items to be considered under each general heading. For instance, under materials we would be concerned with raw stock, finished parts, assemblies, their finish, their tolerances, even their shape, since this affects how they can be packed for shipment. Under the heading of labor, only two subdivisions are required, skilled and unskilled. These can be further classified into engineering, administration, clerical, supervision, wiremen, testers, etc., although many of these classifications are included under general overhead. Included also under overhead expenses are usually such items as purchasing, expediting, incoming inspection, general office work, quality control, plant maintenance, and advertising. Each of the above enters into the cost of a product and accordingly must be considered if savings are to be effected. Table 1 shows a more complete breakdown of the factors involved.

Time Study—Cost Estimating

Working in close collaboration with the design engineer are time study and cost estimating specialists. The time study man is concerned mainly with the ease with which a given operation can be performed and in particular the time involved in completing the task. The cost estimator is concerned not only with the time involved but whether the operation requires the services of a skilled or unskilled operator. He is also interested in the cost of raw materials and completed components; especially when facilities are available within the plant for fabricating these parts. It is his job to determine whether it would be more economical to purchase the part in completed form or to fabricate from raw or semi-raw materials. Because of the large quantities usually involved these estimates must be made to three or four decimal places in order to give a true picture of cost.

All of such data must be available to the design engineer and furthermore he must be capable of using it to the best advantage if savings are to be effected.

Materials and Design

In the design of radio equipment, as in the design of most all products, there must be a reason for everything. *Facts* are all important. With this axiom in mind, the designer should question each step in the development and specification of a new product. Past experience need not be thrown to the winds and each and every step rechecked; obviously such a procedure would not only be costly and time consuming but would serve no useful purpose. In other words, question an item such as the suitability of a material for a given part, but do not question whether or not it will corrode under certain atmospheric conditions, since the latter information is readily available in many design handbooks.

Mechanical Design

The end use of the part is a logical place to begin when selecting a material specification. If the part is purely mechanical and will in no way affect the electrical performance, as for example a dial scale bracket, then such properties as permeability and conductivity need not be considered. Here the designer is mainly concerned with rigidity and strength so it is only

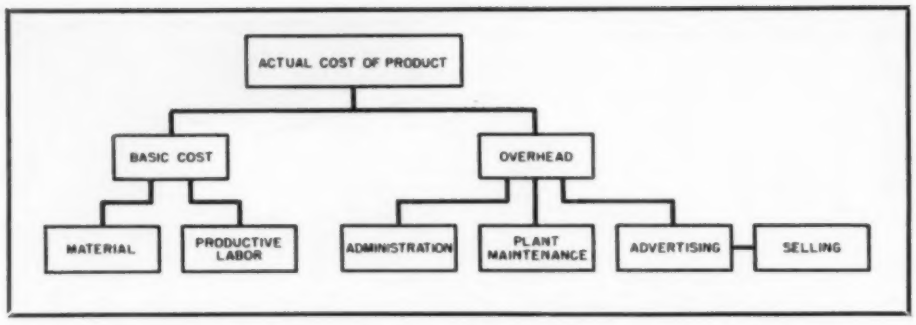
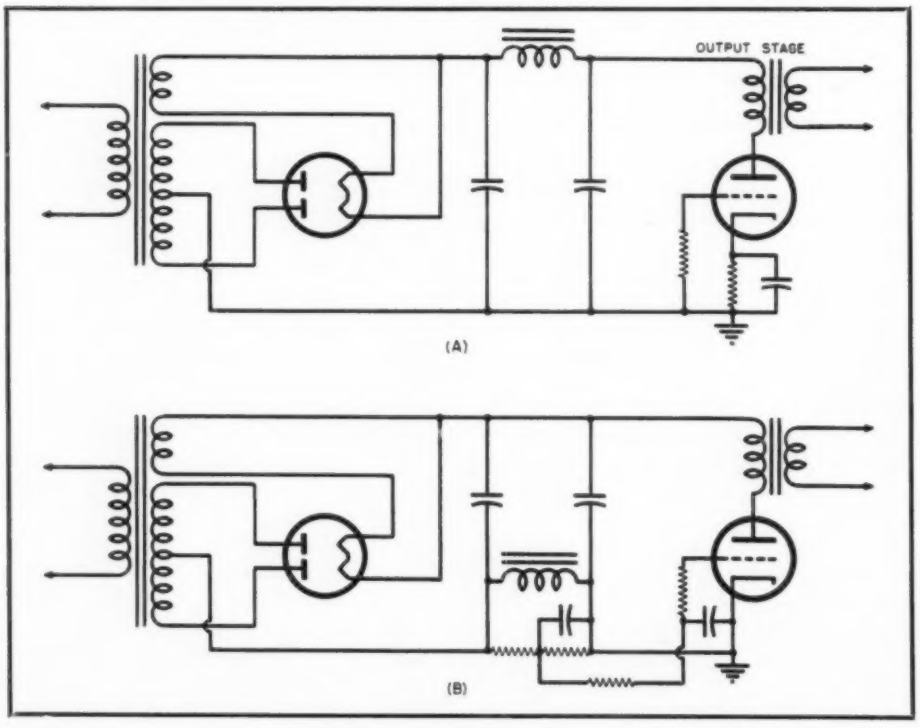


Fig. 1. Breakdown of the cost of producing and selling a manufactured product.

necessary to consider such things as thickness, elasticity, ease of working, etc. The thickness of the metal, of course, varies with the function and design of the part. Often it is possible to specify a thinner metal if the design is such that strengthening ribs or flanges can be added at strategic points. Die costs are usually somewhat lower if thin metal can be used, although the additional cost of strengthening ribs or flanges may outweigh the savings in material. Each case should be considered as a separate problem if the maximum savings in cost is to be obtained. However, if the design is such that the part is quite complicated and requires several operations to produce, this could conceivably influence the choice of the material, in which case it might be better to specify a die-casting instead of a metal stamping. Here the services of a cost estimator are often required because there are so many factors involved with which the average engineer is not familiar. The quantity to be produced may also throw the decision one way or the other.

Another factor—tolerances—must be considered when cost reduction is being studied. Working to fractional dimensions instead of decimals always results in savings on a specific part. However, if wide tolerances bring about complications in assembly then it becomes very questionable as to whether an over-all savings will be made. Tolerances should be as liberal as possible but only to the point which will permit complete interchangeability of production parts. In general, close tolerances are not too expensive (considering the over-all design); it is true the original die cost is higher but the fact that the die cost is usually spread over a large number of units makes the additional cost of little consequence when compared to the ease of assembly and resultant saving in time. It must be remembered that labor costs are relatively high and any saving in man-hours is worth while.

Fig. 2. (A) Typical rectifier-output circuit. (B) Circuit revised for cost saving. Advantages: Lower voltage power transformer, smaller rectifier capacitors due to RC hum filter, and high wattage bias resistor and electrolytic capacitor eliminated.



The choice of hot rolled versus cold rolled material is often a cost factor particularly when it affects this finishing of the part. When a good appearing finish is not required, hot rolled material can be specified at a slight saving. Some materials do not require a finish to prevent corrosion, so unless it is necessary from an appearance standpoint a savings can be made by omitting this operation. It is true that most present day finishes are relatively inexpensive; however, as mentioned previously, costs are determined out to three and four decimal places which often makes the finish specification worth considering.

When sub-assemblies are purchased from an outside source, consideration must be given to the physical shape of the part because this will affect the method or ease of packing. Sections which protrude beyond the main body of the part are definitely a problem. It is sometimes worth while to omit a shaft or bracket from a sub-assembly and assemble it on the final production line in order to simplify the packing for the parts supplier.

Rivets versus spot welding seems like a very small item but the choice of one or the other should not be made without seriously considering several factors. Perhaps one or the other will show definite advantages because the parts to be fastened together will not have to be moved from one department to another. There is also the possibility that if the parts are to be riveted a special size of rivet will be required which will necessitate an additional machine and operator. In the case of spot welding, the number of welds should definitely be specified since each weld represents an appreciable part of a cent of cost.

Another source of savings is where a part can be designed to be used on several models or in several places on the same model. Omit, whenever possible, the need for right and left hand parts because invariably at some time or other a production operator will pick up the wrong piece. Furthermore, such parts are difficult to keep separated in the stock room and the carrying of an extra item, considering the drawings, part numbers and records involved, amounts to additional overhead expense which can often be eliminated.

Savings are also effected in the mounting of parts by including a locating dowel for positioning purposes and at the same time replacing one of the mounting screws. Locating dowels are also used in lieu of holding fixtures when parts are to be spot welded. The use of embossing in place of spacers and punch formed holes for mountings should also be investigated if the quan-

tity to be produced is large enough to warrant the extra tooling involved. The operator would then not have to handle the extra parts (spacers, nuts or lockwashers) and the assembly is greatly simplified. Either self-tapping or regular drive screws can be employed or the punch-formed hole may be tapped if it is necessary to specify a regular machine screw. Along these lines it is often feasible to throw up tabs or small brackets from the main chassis, thus eliminating the need for separate parts. These brackets should be designed in such a manner that no extra operations are required in forming the part. In other words if the bracket or tab can be formed during the same operation that forms the main chassis then worth-while savings are possible, otherwise it might be advisable to continue with separate parts either riveted, screwed or spot welded into position.

The abovementioned possibilities for savings represent, of course, only a few of the total number to be found in almost any design. The main idea in pointing these out is to give an example by which the designer can pattern his work. Work with cost figures and allow past practice to influence the design only when it can be verified by actual up-to-date facts. Methods and costs continually change and must be checked regularly.

Electrical Design

Savings in the electrical design of a radio can be appreciable if the development has been well planned and carried to completion. Due to the many possible circuit combinations it is impractical to discuss all possible sources of savings; it is hoped, however, that the examples given will be sufficiently representative and illustrative to show the general method of procedure.

Usually the first consideration in attempting to design for savings is the choice of tube types. Here as in practically all other instances, up-to-date tube costs are required. In general, using tube types included on the manufacturer's preferred list will result in worth-while savings although there are, of course, exceptions to this rule.

Because of the wide range of frequencies involved in the design of a radio receiver, many grades of insulation or dielectric are required to obtain good performance. Because of this fact it is very easy to specify a higher grade than necessary, and therefore all applications should be studied in order to determine the lowest priced material which will give satisfaction. Many times a leakage problem exists which can be solved by impregnating a relatively low cost insulating material in a suitable wax or other non-hygroscopic material, thereby making a saving even though the impregnation necessitates an additional operation. Of course, in our anxiety to reduce costs the fact that insulators must have good mechanical properties should not be forgotten; it is necessary, therefore, to consider these characteristics as well as power factor or electrical losses.

Resistors and condensers, because of the quantities usually involved, are nearly always a possible source of savings. Here it is important that the wattage, voltage, capacity or resistance ratings be correct. It must be remembered that power line voltages are seldom the same in any two localities and for this reason allowances must be made to provide for such variations. The tolerances too are particularly important; they should be as liberal as possible and yet be consistent with good performance. Never let the quest for savings compromise performance to any great extent, for if the performance is not competitive the design should never be produced.

The audio and power circuits present unusual opportunities for savings. Temperature rise in power transformers can be decreased by careful placement of parts to provide good ventilation with a consequent savings in both iron and copper. Filtering with relatively inexpensive *RC* circuits instead of additional high voltage condensers, bucking of hum in the speaker and the careful location of components and "dressing" of leads should all be investigated. Elaborate audio systems can often be dispensed with by the proper choice of speaker response characteristics. Another widely used method of reducing costs is to connect the speaker field (filter choke) in the low side of the high voltage supply. This "saves" the bias voltage and results in higher plate potentials with a given power transformer, or another way of looking at it, it permits a smaller transformer to be used without sacrificing any power output.

MATERIAL
Raw stock
Semi-finished stock
Finished components
LABOR
Skilled
Unskilled
OVERHEAD
Administration
General Office
Engineering
Planning
Ordering
Purchasing
Expediting
Material Control
Incoming Inspection
Production Supervision
Testing
Quality Control
Packing
Shipping
Personnel
Plant Maintenance
Advertising

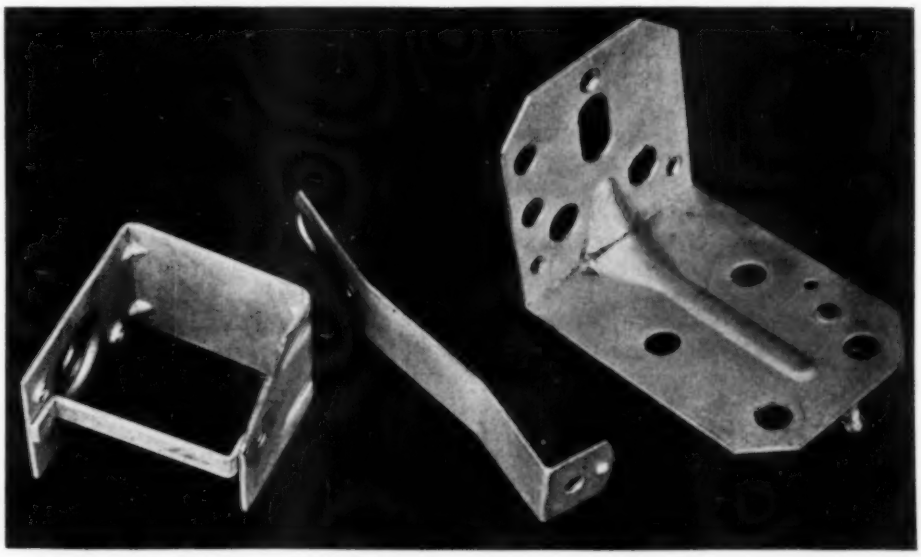
Table I. Some factors involved in the cost of a manufactured product.

Avoid the use of shielded leads whenever possible as they are usually expensive and troublesome in production because of the likelihood of shorts or noise. Shielding by metal plates or better still the proper placing of components is usually more satisfactory.

Probably of more importance than any other single item associated with the electrical design is the layout of parts and wiring. Convenience in wiring through the use of just the correct number of wiring panels, and ease of assembly are of paramount importance because they both directly affect the

(*Continued on page* 23)

Fig. 3. Example of strengthening ribs, dowels and punch formed holes for decreasing costs.



A description of equipment for providing data on the probable useful life of cathode-ray tubes.

By **LEONARD CHIOMA**
North American Philips Co., Inc.

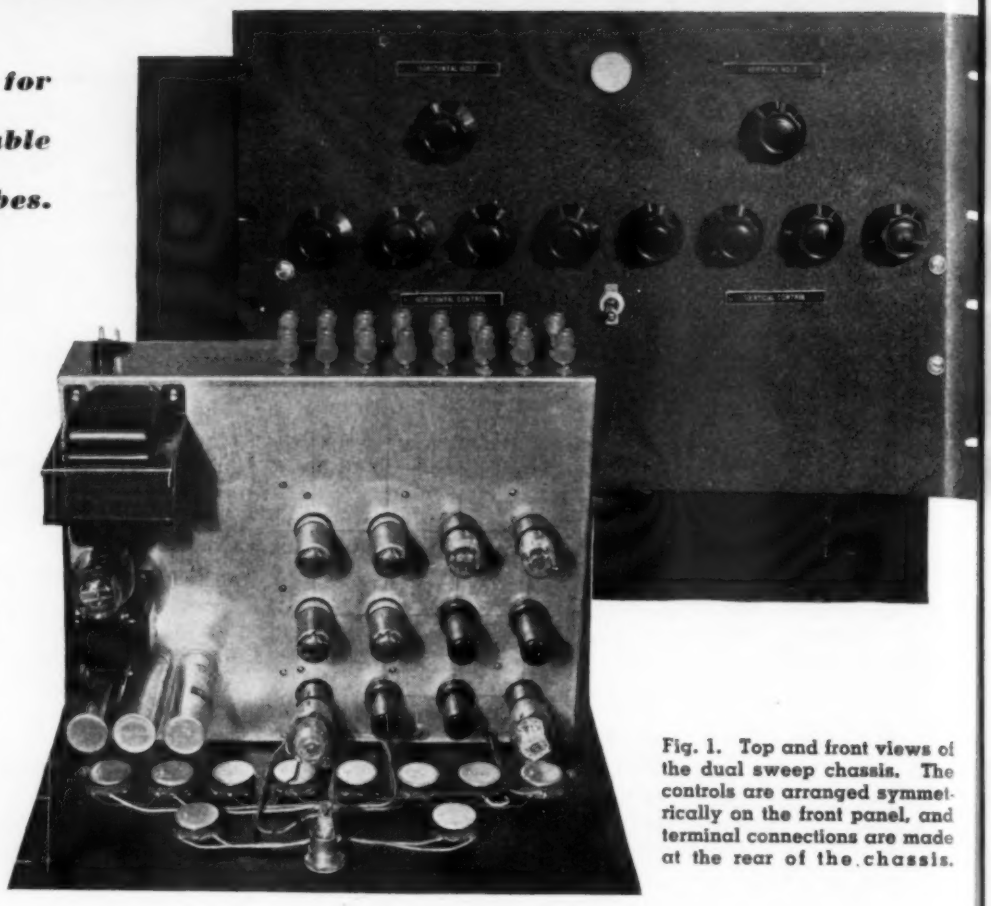


Fig. 1. Top and front views of the dual sweep chassis. The controls are arranged symmetrically on the front panel, and terminal connections are made at the rear of the chassis.

Universal Life Test for C-R Tubes

WORLD WAR II brought about a tremendous expansion of America's cathode-ray tube production. Special applications such as *radar* introduced new types with special characteristics and shapes.

To meet the output requirements of Army and Navy, many new manufacturers joined with old established firms in this all-out endeavor. One of the many problems the newcomers had to overcome was the design of adequate life testing equipment. Specifications (JAN) drawn by Army and Navy provided the general pattern for construction, but each manufacturer developed his own final design with individual variations.

The writer is familiar with many of these life test installations. In this article, a typical 36-position universal life test rack will be described for those who may wish to build or study the make-up of such equipment. Necessary power supplies and scanning circuits required to meet JAN specifications will be briefly discussed.

Data concerning the life of cathode-ray tubes is very important. It is necessary to know how many hours will elapse before electrical and chemical changes make them useless. Tube life cannot be anticipated with any degree of accuracy except through adequate tests conducted on a scientific basis and over suitable periods of time. Established practice specifies that C-R tubes be operated at higher than normal voltages for a period of 500 hours. In addition, some types must maintain a high value of light output or a high beam-to-screen current throughout the life test.

The rack is divided into two separate units. Two master power packs are provided, one for electrostatic types, the other for magnetic types. The complete assembly consists of 8 cabinets so connected that additional units can be installed merely by plugging-in the necessary electrical connections.

When this life test installation was constructed, large cabinets were not available, so eight cabinet racks were redesigned to accommodate tubes of various lengths. Rear doors were removed and reinstalled on extensions. Various voltages needed for particular cabinets are transmitted through plugs mounted on the cabinet extensions.

The electrostatic section accommodates twenty tubes and provides individual grid and focus controls. Three shelves holding 3 tubes each are built into each cabinet of the electrostatic section. Individual doors with glass windows are used on each shelf so that tubes can be visually inspected when under test. The doors also guard the operator from accidental contact with the high voltage. Separate scanning voltages are applied to tubes on each shelf so that various deflection sensitivities can be handled. Tubes are supported by a universal neck and bulb support which can be adjusted to fit 2 to 12″ diameters.

The magnetic section of the rack will handle nine tubes varying from 5 to 12″ in size. Here, each shelf admits only one tube. The bottom section of each cabinet houses the focus supplies, one for each tube position. These three cabinets, like all others, are provided with plugs to facilitate maintenance and the addition of new positions.

Variable Power Supplies

The first anode and grid supply for electrostatic C-R tubes is shown in Fig. 2. The complete power supply unit provides voltages for filaments, grids, and anodes (first and third) of the tubes under test.

The chassis for the filament supply includes two variable voltage sources, one for 2.5 volts and the other for 6.3 volts. A switching arrangement directly below the voltmeter facilitates use of the instrument for checking either the 2.5 or the 6.3 volt source. The next chassis provides for intensifier or third anode voltage and is normally set to the operating value required. The voltmeter is flush mounted on the front panel and is illuminated for ease in reading. This supply is variable to 6000 volts. Still another chassis supplies the voltages for various second anodes. Because some tubes operate on life test with anode potentials of only 1100 to 1650 volts, the main supply is normally set at 2200 volts with the lower voltages taken from a bleeder network. This

supply is variable to a maximum of 2800 volts at 150 milliamperes.

Sweep Circuits

Fig 3 shows front and rear views of the chassis that supplies scanning voltage for all the tubes. Individual vertical and horizontal gain controls are mounted on the front panel. There are four separate vertical and horizontal amplifiers to permit individual control for raster size on each tube. Normally, one output section will suffice for the 27 tubes. However, in this unit (Fig. 3) various outputs are available for tubes having different deflection sensitivities. Fig. 1 shows the sweep chassis which is designed with double outputs.

All cabinet doors (front and rear) are equipped with safety switches. When any door is opened, high voltage condensers are shorted out automatically to prevent accidental shocks to operators and maintenance men. Similarly, opening a door will shut down completely all voltages to the racks. The circuit includes a relay system which must be actuated before normal operation can be resumed. After all doors are closed, the variacs must be turned to starting position before the master reset button is depressed—this restores voltage to all power supplies. A large white pilot lamp, mounted on the main panel, indicates when voltages are on and off. Thus, the operator knows when tubes can be removed safely for their periodic electrical tests. In addition, there is a red pilot light which indicates when voltages are on. Should the white pilot lamp burn out or a safety switch become defective, the red light remains on. This arrangement provides double protection for the operator.

Magnetic Section

All voltages used in the magnetic section (except for focusing) are available from one master source. Focusing supplies are mounted in the bottom of each cabinet. Filament voltages for the magnetic section are derived from the electrostatic section. Other voltage supplies are arranged as follows:

1. A single chassis takes care of first and second grid. The first grid potential is fixed at −210 volts and is fed to individual brilliance controls. The second (accelerator) grid voltage is fixed at ±330v.

2. Another chassis takes care of the second anode and potential is variable to 8000v. at 50 ma. An illuminated flush mounted voltmeter is installed on the front panel of this chassis along with the variac control.

3. A third chassis provides three individually controlled focus supplies.

4. A focus power supply for electromagnetic C-R tubes is provided which accommodates nine tubes. It consists of three units which provide optimum focusing conditions when the coils are adjusted to a value of approximately 94 milliamperes or 423 ampere turns.

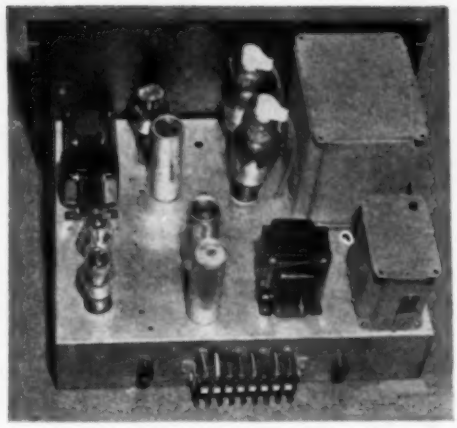


Fig. 2. First anode and grid supply for electrostatic C-R tubes.

Data Covering

Electrostatic Section

1. **Heater section**—2.5 and 6.5 variable supplies.
2. **1st Grid and 1st anode**—Grid fixed at —210V, 1st anode variable to 1000V.
3. **2nd Anode supply**—Variable to 2600V @ 150 ma.
4. **3rd Anode supply**—Variable to 6000V @ 4 ma.
5. **Sweep circuits**—Individual sweep controls for each set of 3 tubes or one master output to all tubes.

Magnetic Section

1. **1st Grid and 2nd grid supplies**—1st Grid fixed at —210V, 2nd grid fixed at +330V.
2. **Anode supply**—Variable to 8000V @ 50 ma.
3. **Focus supplies**—Variable to 350V @ 165 ma.

Table I. Data covering power supplies and sweeps.

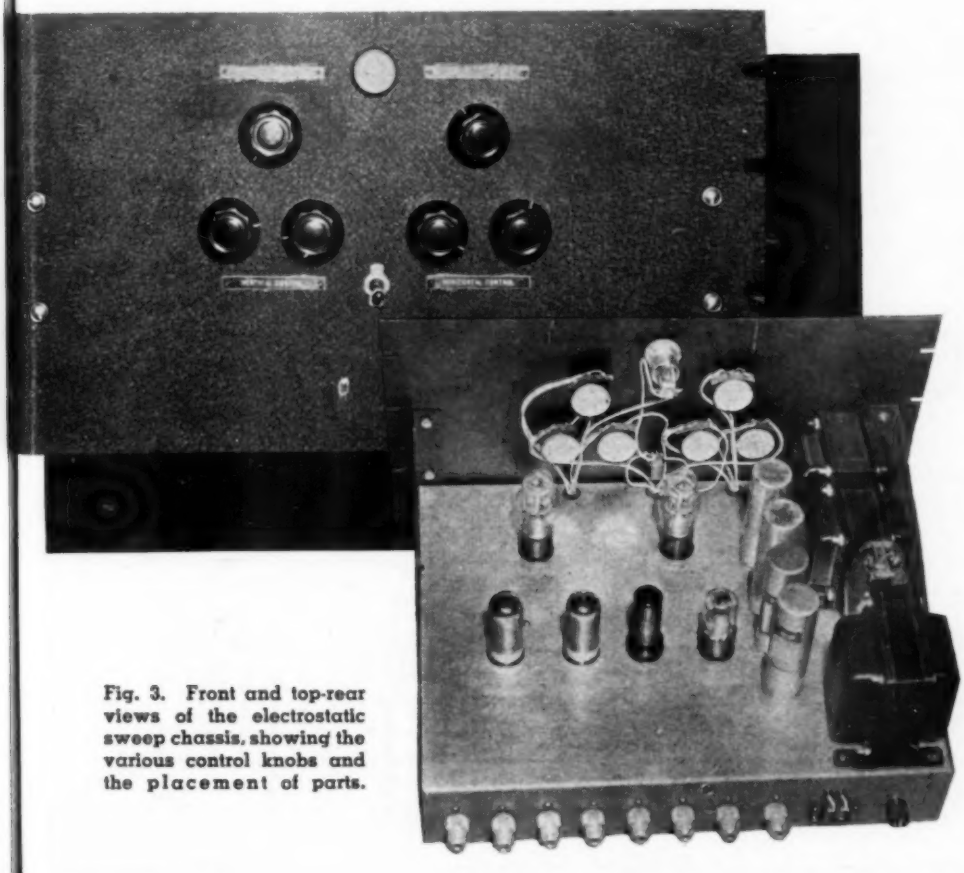


Fig. 3. Front and top-rear views of the electrostatic sweep chassis, showing the various control knobs and the placement of parts.

Each supply will deliver up to 350 volts at a current drain of 165 milliamperes.

Vertical and horizontal scanning voltages for three tubes are provided on one chassis. Individual vertical and horizontal scanning controls are arranged on the front panel while linearity and horizontal dampening adjustments are mounted at the rear. These are screwdriver adjustments which are not disturbed after the initial set-up except when a tube is changed.

The magnetic sweep section is fully equipped with protective switches and relays to safeguard the operator. Two time-clocks record when each section is "on." Thus, it is possible to keep accurate data concerning installation and removal of tubes. These clocks operate only when the second anode voltage is applied. Since the magnetic section supplies potential for magnetic-focus and deflection type cathode-ray tubes, an additional source must be provided if electrostatic focus tubes are to be handled. There is ample room in the power supply cabinet to accommodate this extra equipment.

(*Continued on page* 21)

SERIES–PARALLEL JOINT IMPEDANCE CHART

By ROBERT C. PAINE

The series or parallel impedance of two complex impedances can readily be determined with a fair degree of accuracy by means of this chart.

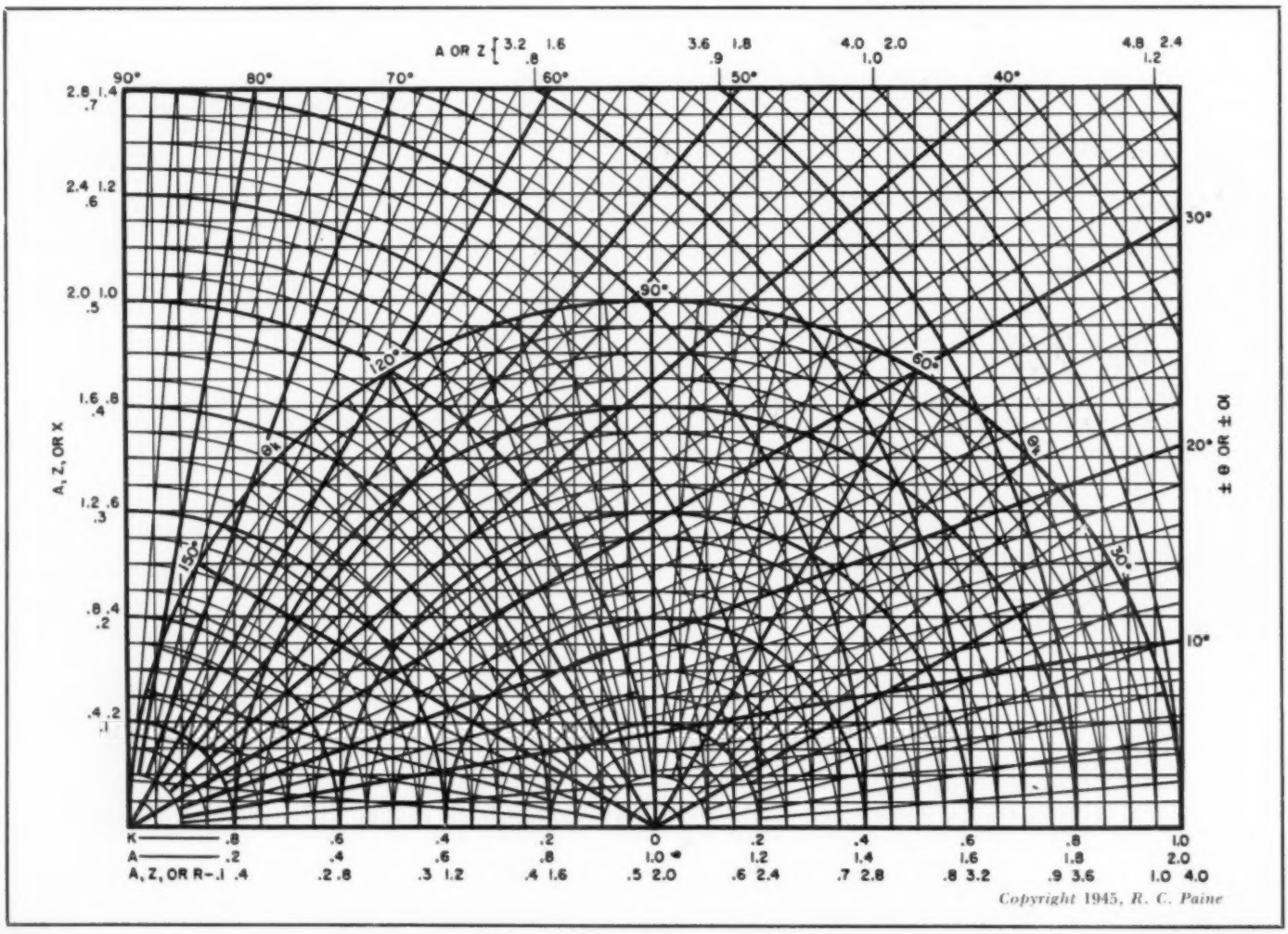
IN network problems complex impedance values frequently must be combined in series or in parallel. Such operations when performed mathematically are often quite laborious. The chart shown in Fig. 1 is designed to simplify these calculations with an accuracy sufficient for ordinary purposes.

This chart is based on the fact that the net impedance of two complex impedances connected in series equals their vector sum or, symbolically, $Z_s = Z_1 + Z_2$. To standardize these relations so that the chart can be used for all values, this equation is divided through by the larger of the two impedance values, Z_1, as follows,

$$\frac{Z_s}{Z_1} = \frac{Z_1 + Z_2}{Z_1} = 1 + |Z_2/Z_1|(\theta_2 - \theta_1) \ldots (1)$$

θ_1 and θ_2, being the phase angles corresponding to Z_1 and Z_2 respectively. The absolute

Fig. 1. Complete chart for performing the various functions which are described in the text.



ratio $|Z_2/Z_1|$ may be represented by the symbol K and the ratio of the impedance angles, or $(\theta_2 - \theta_1)$ may be represented by θ_k. The sum $1 + K\theta_k$ may be represented by $A\alpha$, then $(Z_1 + Z_2)/Z_1 = A\alpha$ and the series impedance of the combination is $Z_s = A|Z_1|(\theta + \alpha)$. The graphical solution of this problem is shown in Fig. 2A where $A\alpha$ is the sum of $1 + K\theta_k$.

In the chart of Fig. 1 all possible values of K and θ_k are shown, the values of K, by the semi-circular loci of constant K, and the values of angle θ_k, by the lines radiating from the center of these circles. The circular arcs whose centers are at the left are the loci of constant A values and the lines radiating from this center mark the value of the angle α. The chart can also be used to find the corresponding vector value $|Z|\theta$ when the impedance Z is given in the rectangular form of resistance and reactance, $R + jX$. In this case, the arcs of A values are used for $|Z|$ and the angular values of $+\alpha$ are used for $+\theta$. The vector solution of this problem is the familiar one indicated in Fig. 2B. Only the positive half of the chart has been shown, in order that it can be drawn to a larger scale for greater accuracy. The negative half is a mirror image of the portion shown, so the part shown can be considered either positive or negative as required; this is illustrated by examples shown below.

The net impedance of two complex impedances connected in parallel is given by the equation:

$$Z_p = \frac{Z_1 Z_2}{Z_1 + Z_2} = Z_2 \cdot Z_1/(Z_1 + Z_2) \ldots . (2)$$

which is seen to be equal to $Z_2/A\alpha$. Therefore, with the value $A\alpha$ found as for the series combination, the parallel impedance can be computed from the equation:

$$Z_p = Z_2/A\alpha = |Z_2|/A(\theta_2 - \alpha) \ldots \ldots . (3)$$

The use of the chart can best be illustrated by the aid of examples as follows:

1. Given two inductive impedances $Z_1 = 5\angle 30°$ and $Z_2 = 3\angle 60°$. From these values we find, by mental computation, $K = 3/5 = .6$ and $\theta_k = \angle 60° - \angle 30° = \angle 30°$. Referring to the chart on the $K = .6$ arc at $\theta_k = \angle 30°$, the values $A = 1.55$ and $\alpha = \angle 11°$ are found. Then the series impedance is computed as $Z_s = 1.55(5)(\angle 30° + \angle 11°)$ or $7.8\ \angle 41°$ and the parallel impedance, $Z_p = 3/1.55\ (\angle 60° - \angle 11°)$ or $1.95\ \angle 49°$. These steps are shown vectorially in Fig. 3 where (A) is the familiar vector diagram of addition for Z_s and (B) is the equivalent operation on the chart. Fig. 3C shows vectorially how the phase angle of parallel impedance θ_p is obtained after the series impedance vector is obtained. Vectorial diagrams for finding the absolute value of Z_p have been omitted in order to keep the diagram simple; such methods have been shown elsewhere[1].

2. Given inductive and capacitive impedances, as in a partially tuned circuit, $Z_1 = 6\angle +80°$ and $Z_2 = 3\angle -70°$. In this case, $K = .5$ and $\theta_k = -150°$, on the chart this point corresponds to $A = .615$ and $\alpha = -24°$, α being considered negative since θ_k is negative. Then $Z_s = .615\ (6)\ (\angle +80° + \angle -24°)$, or $3.69\angle +56°$ and $Z_p = 3/.615\ (\angle -70° - \angle -24°)$, or $4.88\ \angle -46°$. The corresponding vector diagrams are shown in Fig. 3 (D), (E) and (F).

3. Given two capacitive impedances, $Z_1 = 4\angle -30°$ and $Z_2 = 3\angle -50°$. Here $K = .75$ and $\theta_k = -20°$. Chart angles are then considered negative and $A = 1.72$ and $\alpha = -8.5°$. From these values is obtained $Z_s = 1.72(4)\ (\angle -30° + \angle -8.5°) = 6.9\angle -38.5°$ and $Z_p = 3/1.72\ (\angle -50° - \angle -8.5°) - 1.74\ \angle -41.5°$. The corresponding vector diagrams are shown in Fig. 3 (G), (H) and (I).

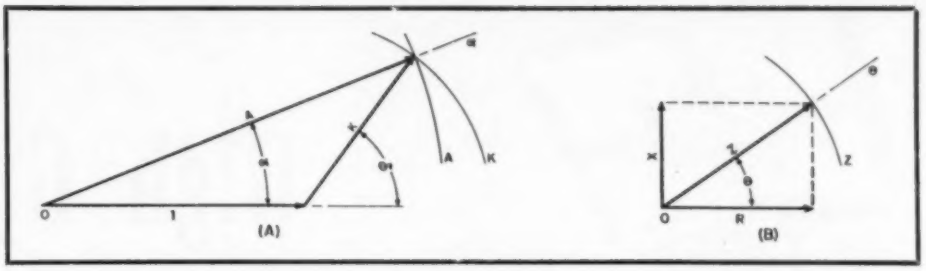


Fig. 2. Graphical representation of the net impedance of two impedances (A) in series, and (B) in parallel.

When impedances are given in terms of resistance and reactance, $R + jX$, they must be converted to corresponding vector terms $|Z|\theta$ for use with this chart. This operation can also be performed by the chart of Fig. 1 as shown in Fig. 2B. To illustrate this feature, consider values $R = 1$ and $X = .75$; these rectangular coordinates intersect on the arc $Z = 1.25$ and the radial 37° and the corresponding vector value is then $1.25\ \angle 37°$. If the value of X were negative, the angle would also be read as negative or $-37°$. Of course, the decimal points can be moved as convenient; these values might be $R = 100$ and $X = 75$ for example, then Z would be 125.

Three separate and corresponding scales are given for R, X, and Z to obtain greater accuracy in reading. They can be used as the given problem indicates. Consider for example, values of $R = 80$ and $X = 60$, these values could best be read on the 0—1.0 scale for R, and 0—0.7, for X, ($\times$ 100). The corresponding value for Z is 1.0 ($\times$ 100). For the scales $R = 0$—4.0 and $X = 0$—2.8, the corresponding Z scale is 0—4.8. Of course, the chart can be used in a reverse manner if required to find values of $R + jX$ corresponding to given values of Z.

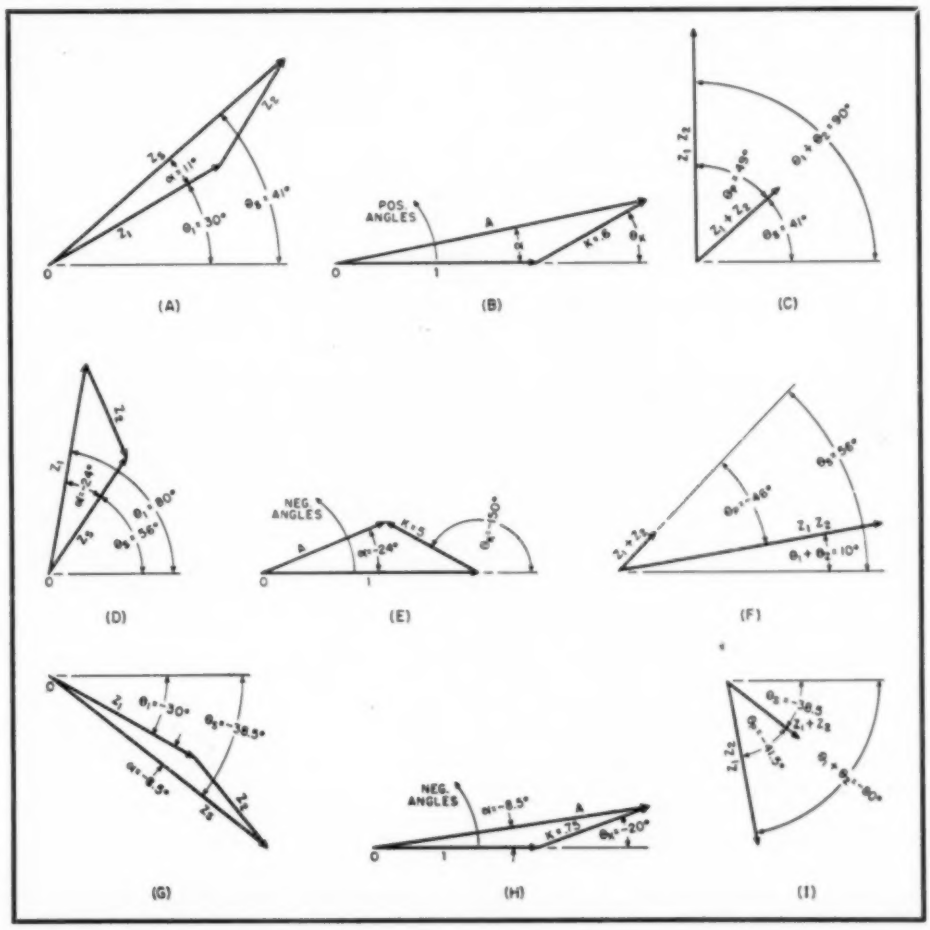
The chart described above is useful for the rapid solution of many problems not requiring extreme accuracy. It is also useful to check mathematical solutions for the careless mistakes which frequently result in serious errors in the final answers.

REFERENCES:

1. *Muffly, Gary, "Impedance Combining Chart," Electronics, P. 134, March, 1944.*

2. *Paine, Robert C., "Some Graphic Solutions of Parallel Circuits," Electronics, P. 90, December, 1942.*

Fig. 3. Graphical representations of the solutions to the three problems presented in the text. (A), (D), and (G) are the familiar vector diagrams for the addition of the two vectors in problems 1, 2, and 3 respectively; (B), (E) and (H) represent the equivalent operations on the chart; and (C), (F), and (I) show vectorially how the phase angles of the parallel impedances are obtained from the series impedance vector.



High Gain Antenna for FM Broadcast

Fig. 1. (Above) Final design of a square loop used for FM broadcasting. Fig. 2. (Right) Experimental loop supported by 2 ft. square lattice tower.

By A. G. KANDOIAN
Laboratories of the Federal Telephone and Radio Corp.

A gain of as much as 20 may be realized by using 16 stacked loops of this new square loop FM antenna.

ACCURATE control and directivity of radiation is desirable at all radio frequencies. The total available radio frequency power being fixed, it is obviously wasteful to radiate energy in undesired directions when it might be made available in the desired direction. At long wavelengths however, though directivity is possible, it is generally not economical since huge antenna installations, large compared to a wavelength, are required. Under these conditions it is generally more economical to obtain the needed power from the transmitter and simply to tolerate the waste of the antenna. Hence, the development of huge amounts of power—average power of 50, 200, 500 or more kilowatts—at low broadcast and communication frequencies.

At higher frequencies, particularly at v.h.f. and u.h.f., directivity is so conveniently and economically obtained that spread of energy in undesired directions is entirely unnecessary, in fact an abuse of the radio spectrum. This is particularly so since with the present state of the art, radio frequency power at v.h.f. and u.h.f., accurately frequency controlled and modulated, is very expensive. Thus large savings, both initial and operating, can be effected by obtaining the maximum feasible directivity or power gain from the antenna system.

Then too, there is the question of transmission losses. As higher and higher frequencies are used, it is evident that the amount of useful power lost in the transmission line and fittings goes up very seriously. Table 1 gives a rough indication of the loss per 100 feet for a variety of common lines.

It is evident that for a normal broadcast installation involving perhaps 500 feet of line, it is not difficult to lose a very appreciable portion of the available power in the transmission line.

This loss must be made up either in the transmitter or the antenna system. However, when the level runs into kilowatts at v.h.f. and u.h.f. it is generally much more economical to obtain the extra gain in the antenna system.

For broadcast application, directivity must be confined to the vertical plane, as a rule, since it is generally desired to serve equally well all areas surrounding a transmitting station. This, of course, seriously limits the amount of directivity, or power gain that the antenna can produce. Nevertheless, a great deal can still be done by confining the radiation in a pancake fashion to the horizontal plane and not waste it into essentially useless directions much above or below the horizontal plane.

The problem, therefore, is to design an antenna system which will be flexible enough to allow enlarging the array in a convenient manner to obtain any desired narrowing of the vertical beam.

Where horizontal polarization is required, such as for FM broadcast, the natural radiating unit to use is essentially the equivalent of the "magnetic" dipole, the horizontal loop antenna, originally developed and used in v.h.f. aerial navigation work.[1] In 1940 a design was made suitable for high power FM broadcasting.[2] Work for this application was, however, interrupted by the war.

The loop antenna proved itself useful in a number of wartime development projects. During these developments one of its major disadvantages was corrected.[3] The disadvantage was in the balanced feeding system. Everyone who has had experience with transmission line circuits appreciates the difficulties and disadvantages of balanced lines, maintain-

ing balance, conversion transformers, etc., as compared with straightforward coaxial circuits. Thus, the basic unit of the FM broadcast antenna system is the coaxially fed loop. Its radiation characteristics have been adequately covered in previous work.[1, 2, 3]

Once the decision was made to use this type of antenna, the problem of a suitable mechanical design for this particular application presented itself. With the shift of the FM broadcasting frequency band to 88-108 mc. the wavelength became shorter and consequently the use of a number of vertically stacked loops to obtain a high degree of directivity or power gain was entirely practical. It was then necessary to visualize how much ultimate gain might be required and determine the mechanical feasibility of such a plan. Reference to Fig. 5 shows how much gain may be expected from a multiple stack of loops for various spacings between them. It was agreed that any structure designed should inherently be capable of a stack of at least 12, and preferably 16, loops.

In order to stack this many loops, approximately one wavelength apart, and still maintain the necessary rigidity, the tower engineers consulted recommended a square lattice antenna supporting structure not less than 24 inches on a side. For the 16 loop case, guying might be necessary, but this is permissible as guy wires, being radial with respect to the loops, have substantially no currents induced in them by the loops.

Thus, it was necessary to make a mechanical design of a loop to have a central 2-foot lattice supporting structure which would cause no harmful distortion of the radiation pattern.

As explained in a previous paper [2] a coaxially fed loop may be made with any number of radiating elements. The smallest number to properly straddle the large supporting structure proved to be four. The most economical design then was a simple square structure which was finally decided upon. A pair of such loops is shown on its 2-foot lattice supporting structure in Fig. 1. A second pair, a more final design, is shown in Fig. 2.

Fig. 7 shows the schematic and impedance relationships in the FM loop design. The input impedance of each loop is made 100 ohms and the two loops tied together with a 100 ohm line. The main feeder then is standard 50 ohm line. The design is such that whereas the impedance at each corner of the square loop is approximately 1600 ohms, with the use of one-quarter wave 100 ohm line and a second quarter wave 50 ohm line the input impedance of 100 ohms is achieved.

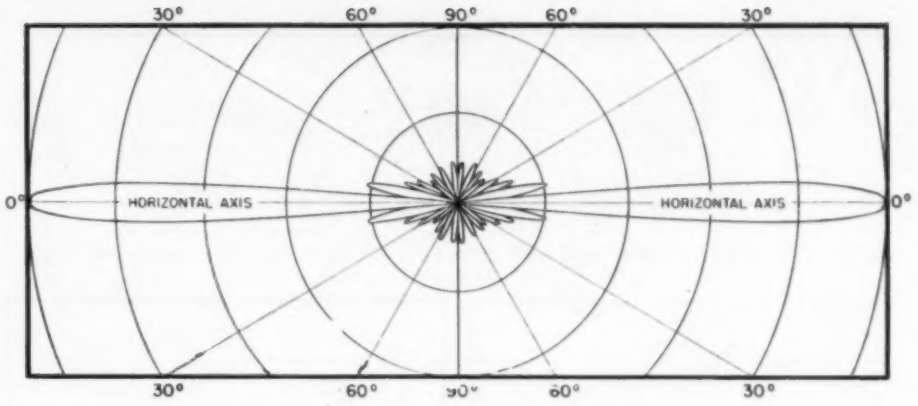


Fig. 3. Vertical radiation pattern of an 8-bay antenna.

A very important problem from the manufacturing standpoint was whether the design could be such as to be fixed for the complete FM band of 88-108 megacycles. A quick investigation proved this to be entirely impractical as it would require huge radiating members comprising the loop and very elaborate exponential lines to feed each element of the loop.

A much more practical idea was to have a single fixed mechanical design for the whole FM band, but provide one adjustment per loop to allow setting to any frequency in the band. After a survey of this problem, together with a series of measurements, this solution proved to be very practical. The parallel input resistance of each loop is nearly constant at around 100 ohms, so it is only necessary to balance out the parallel reactance by means of a single stub. The length of stub necessary for each frequency in the FM range is calculated

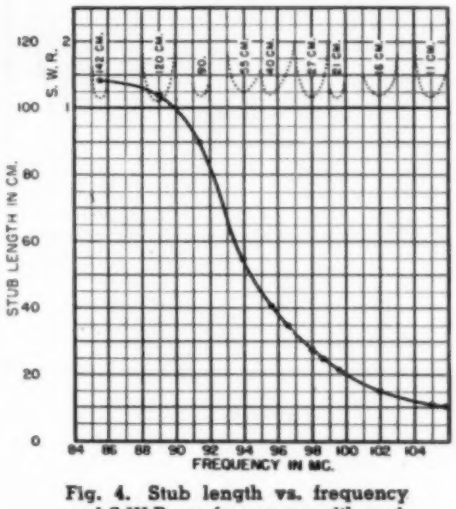
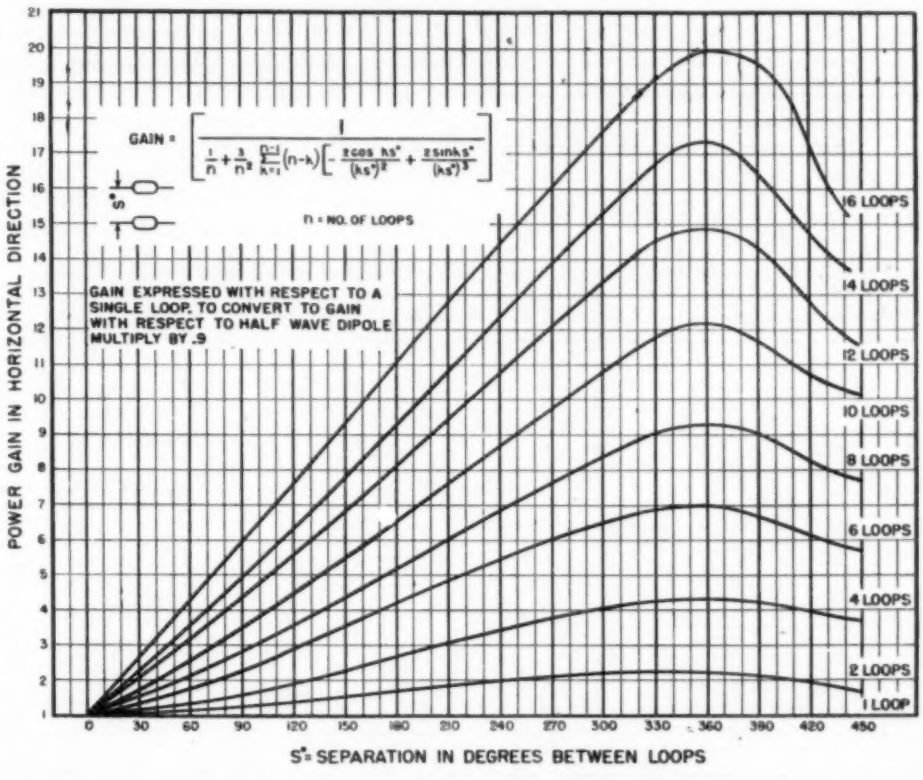


Fig. 4. Stub length vs. frequency and S.W.R. vs. frequency with various stub lengths for a single loop.

Fig. 5. Gain to be expected from a multiple stack of loops with various spacings.



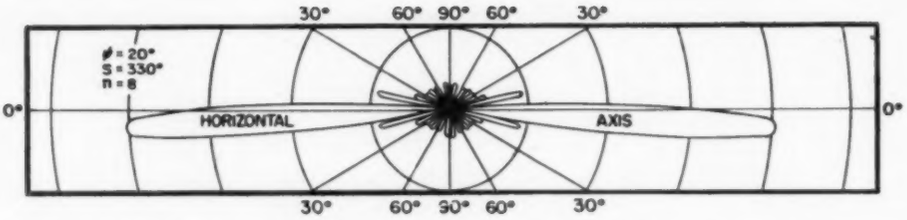


Fig. 6. Vertical pattern of 8 loops with 20° phase difference between successive loops.

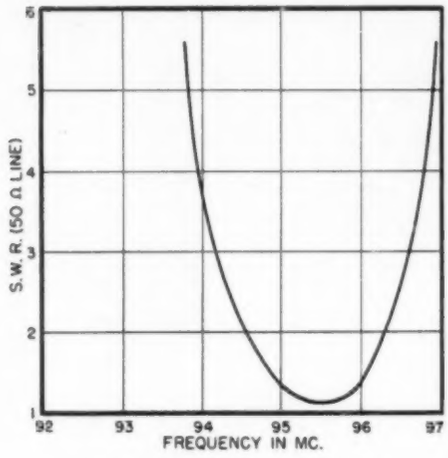


Fig. 8. S.W.R. vs. frequency for square loop designed for 95.5 mc.

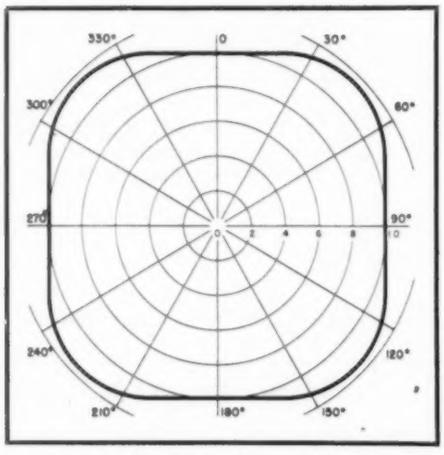


Fig. 9. Calculated horizontal radiation pattern of a square loop.

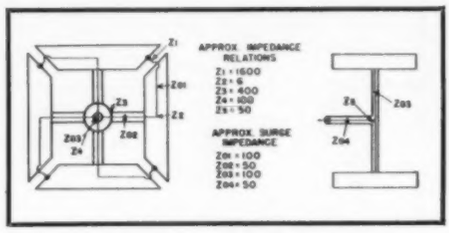


Fig. 7. Impedance relationships in FM square loop antenna.

Type of line	Attenuation db. per 100 ft. 100 mc.	200 mc.	400 mc.	600 mc.
⅞	.46	.67	.99	1.25
1⅝	.23	.34	.51	.65
3⅛	.14	.23	.37	.49
RG-17U	.85	1.3	2.1	2.8
RG-19U	.70	1.1	1.8	2.4

Table I. Rough indication of loss per 100 ft. for various lines.

once for all in Fig. 4 and it is a simple matter then to set each loop to any frequency in the FM range. Fig. 8 shows the mismatch vs. frequency for one condition of operation, stubs for each loop set for 95.5 mc.

In stacking a large number of loops to obtain the desired amount of power gain, the horizontal loop has a fundamental advantage. This is, that its radiation is predominantly in the horizontal plane anyway. This means that very little intercoupling exists between successive loops vertically stacked approximately one wavelength apart. Thus, when additional loops are stacked the original impedance and tuning of each loop is maintained and requires no readjustment.

The remaining problem then is how to make interconnections between pairs of loops. This is done simply by means of a quarter-wave 35 ohm line wherever two 50 ohm lines are joined in parallel. Thus, the 50 ohm level is maintained and all the loops are kept properly in phase to give maximum radiation in the horizontal plane. The schematic for a four loop array is shown in Fig. 10C, while Figs. 10A and B show two alternative feeding systems for an 8 loop array. Generally type 1 (Fig. 10A) is preferred as it allows two main feeders, one of which can be used as standby in case of emergency.

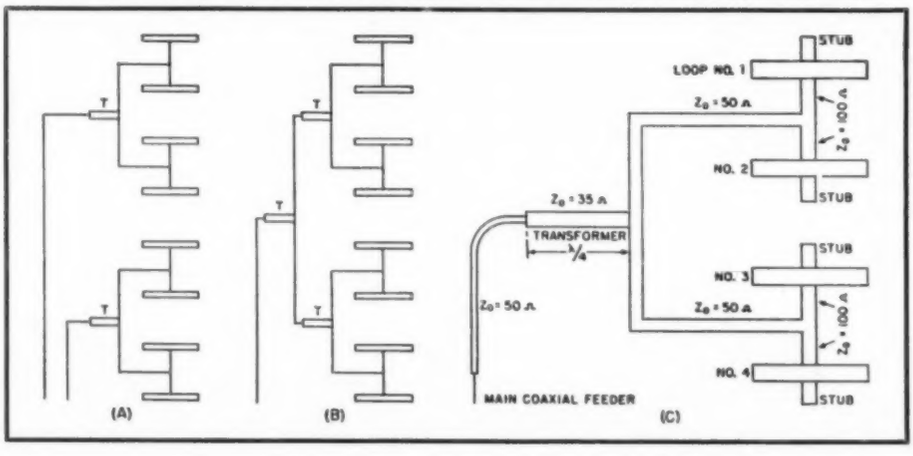


Fig. 10. (A) and (B), two different methods for connecting an 8-bay antenna. (A) has the advantage that two separate channels are used, so if one channel becomes defective, output is only reduced one-half. (C) Schematic of connections for two pairs of loops.

Radiation Pattern

When a loop antenna is made in the form of a square and the current distribution is no longer uniform, the question may be raised as to whether the horizontal radiation pattern is still circular. Assuming a loop one-half wavelength on a side, with a sine wave current distribution, the radiation pattern may be expressed, as a function of horizontal angle θ, by:*

$$F(\beta)=\frac{\cos(90\sin\theta)}{\cos\theta}\sin(90\cos\theta)+\frac{\cos(90\sin\theta)}{\sin\theta}\sin(90\sin\theta)\quad\ldots\ldots(1)$$

which is plotted in Fig. 9.

The vertical pattern of stacked loops all fed in the same phase and amplitude is given by:

$$F(\beta)=\frac{\sin n\left(\frac{s}{2}\sin\beta\right)}{\sin\left(\frac{s}{2}\sin\beta\right)}\cos\beta\quad\ldots\ldots(2)$$

where

n = number of loops
s = spacing between loops in electrical degrees
β = vertical angle measured from the horizon

Fig. 3 shows the calculated pattern of an eight loop array. The gain for this array may be read off from Fig. 5.

For special applications, for example if the antenna installation is on extremely high ground as on a high mountain top, and a high gain antenna is used, it may be desirable to aim the antenna radiation pattern slightly below rather than exactly on the horizon, to give optimum coverage of the surrounding country. This is accomplished by a slight but uniform phase displacement ψ degrees between successive loops of the stacked array, the upper loops being advanced in phase with respect to the lower ones. This is accomplished by displacing each junction point where two lines are tied together (for example in Fig. 10A) upward by a distance equal $\psi/2$ degrees. This will displace the radiation pat-

(Continued on page 23)

* First derived by Mr. Salvatore Milazzo of Federal Telecommunication Laboratories.

Statistical Quality Control of Electronic Components

By EUGENE GODDESS

Factory Engineer, North American Philips Co., Inc.

Intelligent assignment and application of tolerances, along with a suitable statistical quality control system, can greatly reduce production costs.

IT WOULD be unreasonable to expect that every part produced in mass production will exactly meet some no-tolerance specification. The problems arising from these always-present deviations have been offset to some extent by the science of Statistical Quality Control, which has aided electronic engineers enormously in setting up and maintaining intelligent tolerances. In this article, the writer reviews some typical work involving electronic circuit components.

Prior to describing some of the applications of statistical quality control to electronic industrial practice, we will describe very briefly (leaving out many very important details) how the controls operate.

Suppose we wish to control the inductance of a coil which is made on an automatic winding machine. The coils are supposed to have 1 microhenry of inductance. First, a sample of 5 coils is taken periodically (each hour, each shift, etc.), and the average value, X, is computed. Second, the difference in value between the largest and the smallest is determined—this value is termed the range, R, a sample computation being shown in Fig. 1. These values are then plotted on suitable graph paper. After a number of these averages, X, and ranges, R, have been plotted, they are treated statistically to establish mathematically the limits within which the winding machine might be expected to work. (This is only one type of statistical control, many others are available.)

If at some time these measured values should exceed the control limits, then it is assumed that the variations are large enough to be due to assignable and removable causes rather than due solely to chance. When such causes are sought out and removed, subsequent periodic sampling will give in-limit values of X and R.

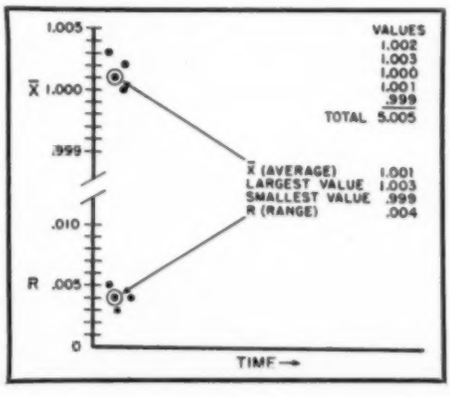
Because much has been written on the details, theory and practice of statistical quality control, repetition here will be avoided, but the reader's attention is directed to the bibliography appended at the end of this article.

Statistical methods should be used to establish intelligent, enforceable tolerances. Suppose further in our example, (1) that the tolerances given in the blueprint were $+.1\mu h$. The shop, however, by negotiating with the inspector had the latter actually use a tolerance of $+.2\mu h.$, $-.3\mu h$. Examination of the actual product coming from the machine showed that tolerance of its product was $\pm.3\mu h$. Meanwhile the impedance bridge used by the inspector was found to be accurate, $+.3\mu h.$, $-.2\mu h$. Further investigation showed that the product would be perfectly suitable if the inductance varied from the specification by as much as $.4\mu h$. All this trouble would have arisen because the customer was needlessly stating a specification tolerance of $\pm.1\mu h$. Usually, moreover, when tolerances are reduced in an arithmetic progression, the cost of production increases approximately as a geometric progression having a common ratio of 2. Thus, for example, if it costs \$1 to maintain a tolerance of $\pm.4\mu h$. it will cost \$2 to maintain a tolerance of $\pm.3\mu h.$, \$4 for a tolerance of $\pm.2\mu h.$, and \$8 for a tolerance of $\pm.1\mu h$. The cure may be effected by adopting the broadest permissible tolerances, and enforcing them with the quality control technique. Waste, due to excessively tight tolerances, is thereby eliminated.

Control records over a period of time will often indicate in advance how many pieces can be made by a given die. By changing dies at anticipated intervals, it becomes possible to reduce the number of out-of-specification parts. If printed tolerances are based on a utility standard, then the use of a given die can easily be extended. This applies to parts such as variable capacitor plates, metal chassis, electron tube parts, and radio hardware of precision type.

The question of tolerances is a serious one. As a simple example, consider the manufacture of open-end wrenches and spinner type nut wrenches found on every radio tech-

Fig. 1. Sample computation and plotting of X (average) and R (range) for data discussed in text.



nician's bench. In both cases, a statistical analysis should be made before production is undertaken at all in order to determine the optimum economic wrench size. First, nuts of the given size produced by different manufacturers should be analyzed. Depending on the source of supply, these tolerances will vary. Second, the wrench must be designed to fit easily over the largest nut—yet, it must not slip when a torque is applied to the smallest. Third, machinery used to produce the wrench should be analyzed to determine what accuracy is inherent in such equipment. Fourth, we should apply the broadest economic tolerances commensurate with a good product to determine whether it can be made in the factory under study. The requirements uncovered by these statistical analyses may show that it is not wise to produce the wrench at all. Finally, if it is to be produced, quality control techniques should be carefully applied to insure that the product is held to specifications. While we have used this example because of its simplicity, the same problems exist in the design of almost all electrical products, especially the tolerances of such items as vacuum tubes.

Suppose we have a triode electronic vacuum tube designed to supply 35 milliamperes at a grid voltage of —20 volts and a plate voltage of 1000 volts used in the r.f. portion of a transmitter. Now each tube will differ slightly. Moreover, the bulk of the tubes will vary from manufacturer to manufacturer. The circuit using this tube must be designed so that it can handle the large variations in plate current which occur. That is to say, the components must be able to handle the greatest currents without excessive distortion or failure due to excessive power dissipation. In addition the circuit must not lose so much power at the lower current values that it fails to perform, i.e., its transmitted power output fails to attain the required level. In most transmitters this problem is taken care of by the usual technique of tuning. *But*—in the pretuned type of transmitter, where circumstances often require tube replacement and use without further adjustment, this factor of tolerances must be considered.

An excellent instance of using the statistical method for the control of quality of electronic components is given by the Hunter Pressed Steel Co.[3] In this case, large quantities of pointer assemblies were purchased for use in an automatic radio tuning mechanism, which was comprised of a stamping soldered to a "D" shaped ferrule. Alignment between the center line of the "D" and the pointer center line was required to be maintained at ±½ degree. Using a special gauge for accurately measuring the angle, the incoming inspection department discovered that a large percentage of these pointers were outside the ±½ degree angular tolerance. A distribution curve was made of the product and the result is shown in Fig. 2.

Based on these data, it was concluded that the two soldering fixtures which were being used were themselves accurate to a ±½ degree but were off angle ½ degree and 1½ degrees in a counter clockwise direction. These deductions were subsequently verified and the fixtures were corrected. The result was higher quality electronic parts.

With the forthcoming demand for ultra-high-frequency radio equipment, many of the usual elements take on strange forms. Wires often become pipes. A transformer may consist of two pipes side by side. In fact, much of the equipment will be of the "trombone" variety, and manufacturers who intend to produce this precision plumbing will be required to extend their machine shop activities. Important is the fact that at these frequencies specified tolerances must be rigidly maintained or radio efficiency suffers. In one typical "trombone" problem involving telescoping parts, the trouble was detected by statistical methods and a more uniform product resulted with a reduction of inspection costs to ⅓ their former value.

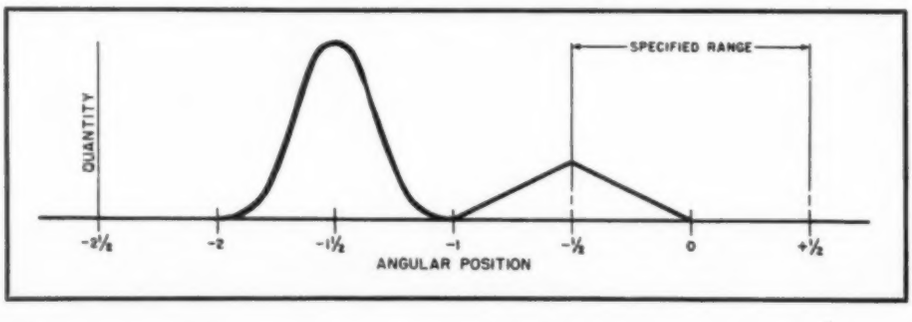
In general, automatic machine products having out-of-limit values should cause first the measuring device and then the machine to be challenged. Of course, this assumes that the work going into the machine is good. Ceramic extrusion machines, automatic winders, and punch presses are all suitable for quality control techniques. This type of process control requires that the person heading the activity fully appreciate what can be done. Training (by study and experience) of the statistical quality control operators who will actually do the work is a basic requirement. Shop foremen and supervisory help must be educated and "sold" on the whole idea.

At least one of a group of foremen is likely to be interested in the quality control plan, which should never be forced into existence. Instead, the activity should be instituted where it will be most welcome, will receive the best cooperation, and consequently has the best chance to "make good." Its success in its initial trial will largely govern how it will be received in other departments.

A word of caution—all processes are not capable of being controlled initially. So erratic are some operations, due to machine deficiencies and operator eccentricities, that to attempt a control is useless until some of the basic difficulties are untangled and the product shows some semblance of being the result of intent rather than of chance alone.

The electronics industry, because of its inherent nature, is a mass production activity. Economy of design both of circuits and components can be achieved by the use of statistical methods, which in the final analysis constitute only a mathematical formulation of common sense principles. The advantages of these methods arise from the more reliable quantitative results which can be reached through the application of exact mathematical techniques.

Fig. 2. Frequency distribution of accuracy of pointer assemblies in sample data referred to in text.



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Personals

BEN ADLER, until recently chief facilities engineer for the *American Broadcasting Co.,* is vice-president in charge of engineering at the *Transmitter Equipment Mfg. Co., Inc.,* of New York City. During the war he served as manager of the Test and Measuring Equipment Section for *RCA,* directing development of special test procedures on radar and other military projects. Mr. Adler holds a patent on a large screen television projection system.

F. ELLIS JOHNSON, former dean of the Colleges of Engineering at the University of Missouri and the University of Wisconsin, has been selected to head educational activities at the *Hanford Engineer Works* at Richland, Wash. The management of *Hanford,* organized by *E. I. duPont de Nemours Co.* for the United States for the further development of atomic energy, was recently taken over by *General Electric Co.* and assigned to its Chemical Dept.

RAY C. BIERMAN has assumed the position of senior electrical engineer at the *Webster-Chicago Corp.,* 5610 Bloomingdale Ave., Chicago. Formerly chief engineer with *Permoflux Corp.,* Chicago, and prior to that a broadcast engineer with *NBC* and *ABC,* Mr. Bierman is a member of the Acoustical Society of America. He is in charge of the development of new electronic devices, including wire recorders and small motors, at *Webster-Chicago.*

DR. B. J. MILLER has been named chief of the recently-organized Guided Missile Electronics Section of the National Bureau of Standards. Dr. Miller joined the Bureau's staff in 1943 and before that taught physics at St. Ambrose College and applied mathematics at St. Louis U. As a physicist in the Ordnance Development Division of the Bureau, he aided in research on the radio proximity fuse, one of the most closely guarded devices of the war.

ALOIS W. GRAF has announced the opening of an office in Chicago for the practice of law in patent and trademark causes. He is on the executive committee of the Illinois Engineering Council which sponsored the enactment of the Illinois professional engineer registration law. Chairman of the Chicago Section, Institute of Radio Engineers, Mr. Graf is also active in the Chicago Technical Societies Council and the National Electronics Conference.

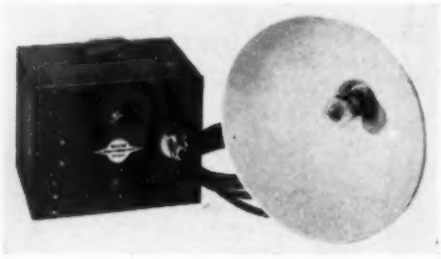
ERNEST L. WARD has been elected as a vice-president of the *Sprague Electric Company,* North Adams, Mass. Coordination of the manufacturing and service activities of the company will be the duty of Mr. Ward, who joined the firm early in 1946. Previously in the investment banking field, he specialized in industrial operations and organization and was a partner with *F. S. Moseley and Co.* of Boston. He graduated from Princeton University in 1929.

NEW PRODUCTS

PORTABLE STROBO-LIGHT

High-speed action shots can be taken with an ordinary camera with the use of the a.c.-operated Portable Strobo-Light, now being made available at a moderate price by *Kluge Electronics Co.*

The light, adaptable for home portraiture as well as commercial use, incorporates several advanced features despite the lower price, including use of a K-60 Sunlight Spectrum

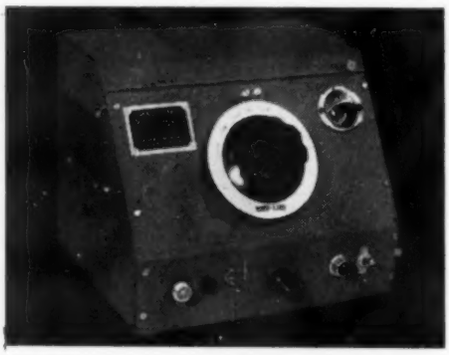


bulb which gives sunlight quality on color work, indoors and out, without filters. The bulb will take an estimated 10,000 pictures and light intensity is rated to approximately 100 times that of sunlight.

Further information may be obtained from *Kluge Electronics, Inc.,* 1031 N. Alvarado St., Los Angeles 26, Cal.

MICRO-MIKER

Measuring shunt capacity rather than series capacity, the *Kay-Lab* Micro-Miker is especially designed to measure the small capacity appearing in the wiring of an amplifier, although



it may also be used to measure the inter-electrode capacity of vacuum tubes or other small capacities between 1 and 200 μμfd.

The new type of impedance measuring instrument is capable of recording shunt capacity even though the unknown condenser is shunted by a resistor as small as 1,500 ohms.

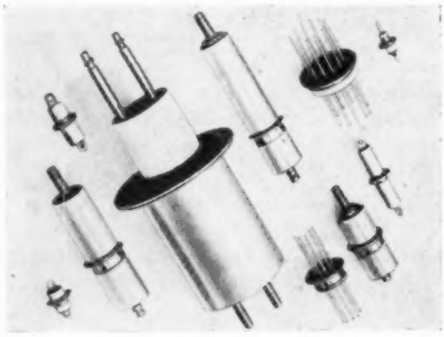
Consisting of three instruments in one, an oscillator, an impedance bridge and a tuned detector, the Micro-Miker's principal applications are in building amplifiers for good high frequency response and as an aid in designing peaking coils for video-amplifiers.

Bulletin 4-J, supplying additional information, may be had by addressing *Kalbfell Laboratories,* 1076 Morena Blvd., San Diego 10, Cal.

SEALEX BUSHINGS

Permanent hermetic sealing capable of withstanding unusually severe mechanical and thermal shock is afforded in an expanded line of sealed bushings suitable for practically all electrical and electronic applications and being marketed under the trade name, Sealex, by the *General Ceramics and Steatite Corp.*

The steatite dielectric is chemically bonded to the metal collar and elec-



trode, with the coefficients of expansion of the steatite and metal matched to insure a bond unaffected by frequent or even violent temperature fluctuation.

Every Sealex bushing is subjected to an air pressure test of 50 p.s.i. prior to shipment and all metal parts are hot tinned to facilitate soldering. Either individual leads or multiple headers with up to 16 leads are available in standard types.

Further information may be obtained by writing to *General Ceramics and Steatite Corp.,* Keasbey, N. J.

NEW THREE-POINT GAGE

Instantaneous measurement, not only of all sizes of pipe from ⅛" to 12", but also of all sizes of electrical conduit, both heavy and thin wall, is made possible with a new model of the Three Point Gage.

The pocket-size gage shows accurately the size of the pipe or conduit, when the two fixed contact points of one plate are placed against the outer contour and the movable plate is adjusted to make a third contact. The

instrument can be applied in dark places and taken to the light for reading.

Further information may be obtained from the *Three Point Gage Co.,* 3767 N. Racine Ave., Chicago 13, Ill.

ELECTRONIC STOP-WATCH

The *RCA* Time Interval Counter, an electronic stop-watch which can clock pulses of as little duration as one millionth of a second, is being produced for the first time in quantities for science and industry.

Developed during the war and used for measuring projectile velocities at the Army's Aberdeen Proving Grounds, the instrument can be used to measure velocities and accelerations for intervals up to 1.0 second in steps of one micro-second. Redesigned for peacetime applications in the *RCA* Model WF-99B, the counter can record the opening and closing

times of circuit breakers and relays, as well as impulses from generators, switches and other electrical devices.

The device is particularly suitable where speed requirements are too fast

ror conventional counters and where high-speed continuous operations or slippage and wear constitute a major problem.

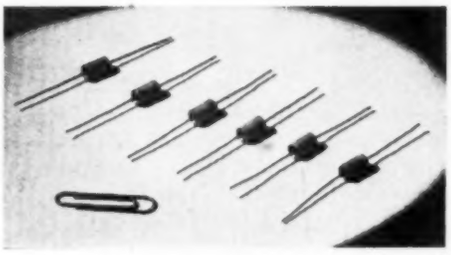
Direct results can be read by means of small neon-light figures on the front panel of the instrument.

HIGH BACK-VOLTAGE DIODE

A new germanium crystal diode, with a safe forward current of .05 amps and a safe back voltage of 60 volts for radio and television receiver and other equipment applications, has been developed by the Specialty Division of *General Electric Company's* Electronics Department.

Point-to-plane contact between a micro-sharp platinum wire and the face of a specially-processed germanium crystal is featured in the new diode, which will serve as a rectifier, modulator, detector or voltage regulator. *G-E* engineers report the diode will handle higher voltages than any of its type. Its very low inter-electrode capacity and high forward conductance permitting a low resistive load make it useful in FM and television applications.

Weighing several grams with a body length of $\frac{23}{64}$" and diameter of $\frac{7}{32}$", the high back-voltage germanium



crystal diode furnishes an inter-electrode capacitance of approximately .2 $\mu\mu$fd. and has a life performance of at least 3,000 hours. Units dropped 10 successive times to a hard wood block from a distance of 30 inches have not been impaired in performance, indicating extreme sturdiness.

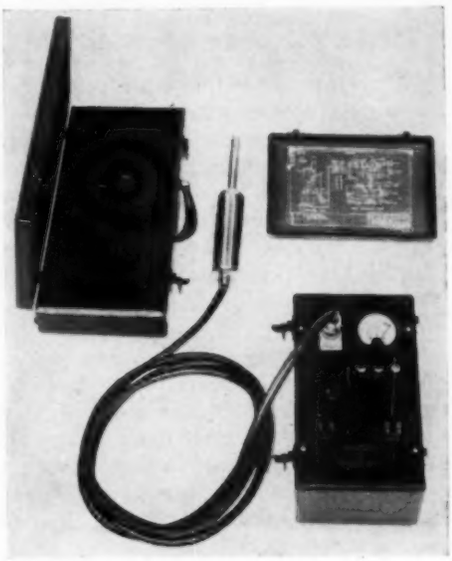
Further information is available through the Specialty Division, *G-E* Electronics Department, Wolf St. Plant, Syracuse, N. Y.

SOUND PRESSURE MEASUREMENT

Massa Model GA-1002 Sound Pressure Measurement System is a precision electro-acoustic instrument for conveniently making absolute sound pressure measurements over the entire audible and early supersonic frequency range to about 40 kc.

Its rugged design makes it practical as an every-day piece of working apparatus without fear of damage or change in calibration. The complete system includes the Model M-101 standard microphone, a shock-mounted preamplifier with a 15-foot cable and an auxiliary amplifier complete with dry batteries.

Among the applications for the equipment are absolute free field



sound measurement; sound pressure measurement inside small enclosures, horns, conduits, etc.; wave front analysis in sound propagating apparatus; pilot microphone for intensity control of sound fields; reference standard for

(*Continued on page* 27)

Universal Life Test

(*Continued from page* 11)

This life test unit has been designed to provide maximum flexibility. New types of cathode-ray tubes requiring voltages different from those available can be accommodated easily by installing additional cabinets. For continuous operation, it is best to use heavy components so as to minimize electrical breakdowns. Each chassis should be designed for easy removal and maintenance.

Now that World War II is over, cathode-ray tubes will become increasingly important for television. Direct viewing and projection types will become prime subjects for life tests. Most of the aforementioned power supplies can be used for such work. Two additional units will also be needed, one to provide 20 kilovolts for the second anode, and one to supply 15 kv. for electrostatic focusing.

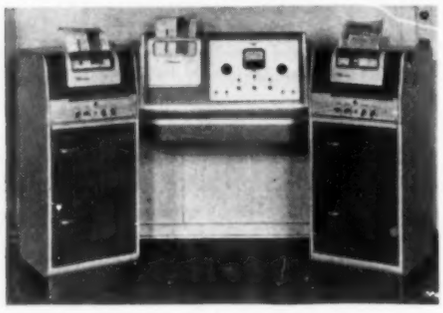
To scan the 10" direct-viewing tube satisfactorily with this life test equipment, it is necessary to fold back part of the deflection-yoke coils. Unless this is done, the raster would be a large circle (instead of a square) at maximum scanning. Of course, where a large amount of this work is to be done, a deflection yoke should be installed.

Industrial Review

Facsimile System

THE *Finch* broadcast studio facsimile transmitter-monitor system, shown in the photograph, is one of the recent developments of *Finch Communications, Inc.,* of Passaic, N. J., manufacturers of facsimile equipment and other electronic apparatus.

Designed primarily for FM broadcasters, the transmitter-monitor system consists of monitor-control desk, two *Finch* high-quality precision



broadcast facsimile scanners, each with associated monitor receiver, power units, amplifiers and selective switching arrangements for insuring uninterrupted transmission for any number of facsimile pages.

Provided with *Finch* automatic copy loading and ejection, it also includes a receiver operating on the outgoing signal of the unit, thus making it possible to observe the program. Two complete scanning units are supplied with control console to facilitate an uninterrupted flow of news programs to homes, thus making it possible to start a new page as soon as the preceding page has been transmitted.

FM broadcasters due to install the apparatus include WGHF and WMGM, New York City; KMGM, Hollywood; KJBS, San Francisco; WJJD, Chicago; WENA, Detroit; the San Bernardino Broadcasting Co., San Bernardino, Cal.; Western Reserve Broadcasting Co., Cleveland, and the Board of Missions of Church Extensions of the Methodist Church, New York City.

* * *

Powerful Electro-Magnet

AN electro-magnet so powerful that the operator must stay at the controls four yards away when it is at peak operation to avoid having his pockets picked has been developed by Dr. J. E. Golman of the *Westinghouse Research Laboratories.*

Oil-cooled, it is a 1½ ton, iron core, electro-magnet wound with 6,000 turns of square copper wire and tipped with a special magnetic alloy. Five feet long and 2½ feet high, the magnet has adjustable poles so that specimens from 1½ to 12 inches may be attracted and is capable of exerting a concentrated 4,000 pound pull, a force strong enough to make possible new studies in magnetism.

One secret of the high magnetism produced is the special alloy tips, developed by the *Westinghouse Research Laboratories* to give more magnetic energy than ordinary iron.

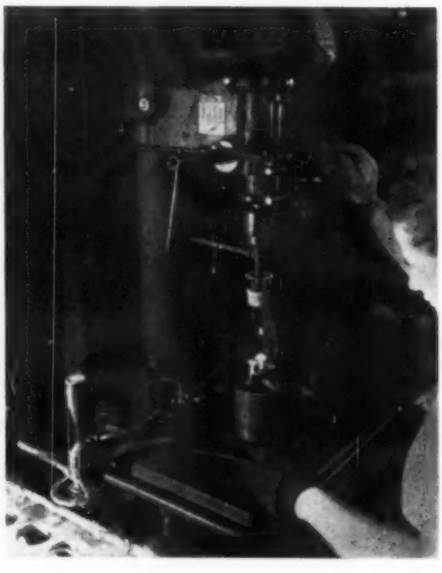
The variation in the gap between poles is accomplished by the use of adjustable tapered pole pieces. This feature adds immensely to the versatility of the 28,000-watt magnet. Cooling is accomplished by a flow of 17 gallons of oil per minute through the coils.

The new magnet can be used as an aid to the design of cyclotrons, for the production of small permanent magnets that will make possible smaller and lighter aircraft instruments, and as a fundamental research tool for the study of the relationship between the crystal structure of metals and their magnetic properties.

* * *

Glass Forming Technique

THE operator "blows" bosses in an 834 (VT 62) high frequency tube



at the Brooklyn plant of *Amperex Electronic Corporation.*

After the two oxygen-hydrogen jets have heated the glass to the pliable state, they are swung out of the way and the bulb is lowered into the mold. Then air pressure is applied inside the bulb and the glass forms two stems at the points provided in the mold.

The bunsen burner is used to preheat and anneal the bulb before the bosses are blown. The completed tubes get a final annealing in temperature controlled ovens.

* * *

"Tube Icebox"

A TESTING chamber for electronic tubes, capable of simulating altitudes up to 80,000 feet at temperatures ranging from 100 degrees F. below zero to 175 above under humidity conditions varying from rainy to arid,

has been announced by the Tube Division of *General Electric Company's* Electronics Department.

Called a "tube icebox" and originally designed to test tubes for wartime aircraft equipment, the chamber is now equipped to handle multi-purpose testing of all tube types.

Two dials outside the door automatically control, operate and record, on a 24-hour chart, conditions within the chamber. Six panes of glass in the door of the unit, the last about an inch thick, assure maximum stability of altitude, humidity and temperature ranges. The internal working area of the chamber is 3 feet wide, 3 feet high and 5 feet deep. The over-all equipment occupies a space of approximately 7 feet by 8 feet by 15 feet.

Leads into and out of the chamber furnish the engineers with detailed information on tube operation under varied conditions. Connected to a terminal board on one side of the chamber where measurements can be made are 20 standard leads, 12 pair of thermocouple leads and 3 high frequency coaxial leads. Four pipes through the walls of the "tube icebox" also make provision for the testing of forced-air and water-cooled tube types.

Altitude is attained at the rate of 3,000 feet a minute while 100 degrees below zero can be reached in about 2 hours, with 175 degrees above zero

simulated in about 45 minutes. Elaborate refrigeration and pumping equipment located back of the chamber make possible attainment of desired conditions in a relatively short time.

* * *

Reflex Klystrons

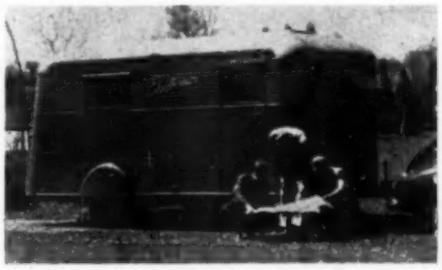
A TINY reflex klystron is lighted up for the first time in the Research Laboratory of *Sylvania Electric Products, Inc.*, Flushing, New York. The

tubes operate between 6 cm. and 15 cm. wavelengths. Over-all length of the finished tube is only three inches.

* * *

Lab on Wheels

GENERAL ELECTRIC will soon have in operation eight "roving" radio laboratories" installed in colorful trailers and equipped with electronic testing and repair facilities for a variety of radio communication services. These laboratories on wheels will operate from Albany, N.Y., Boston, Cleveland, Chicago, Philadelphia, Kansas City, Atlanta, and Dallas. To enable proper location of radio transmitter sites, the laboratories will be equipped with transmitting equipment to make field strength surveys for proper location of transmitters. Other technical electronic apparatus will provide facilities



for testing many kinds of radio circuits and equipment to fix trouble "on the spot" in some cases.

Outlets now available for new radio communication services and the tremendous growth of radio in the fields of public service, safety, transportation and industry warranted these laboratories for field service operation.

High Gain Antenna

(*Continued from page* 16)

tern downward by a factor of approximately ψ/n degrees where n is the number of loops in the stack. The radiation pattern under these conditions is given by:

$$F(\beta)=\frac{\sin n\left(\frac{s}{2}\sin\beta+\frac{\psi}{2}\right)}{\sin\left(\frac{s}{2}\sin\beta+\frac{\psi}{2}\right)}\cos\beta \quad \ldots\ldots\ldots (3)$$

Fig. 6 shows the pattern on an eight loop array of this type, where successive loops are displaced 20 degrees in phase.

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Design for Saving

(*Continued from page* 9)

labor costs. When too many leads or wires must be soldered to a single terminal, the efficiency of the wireman is decreased, the joint tends to become sloppy and the possibility of poor soldering increases, not to mention the fact that excess solder is likely to become lodged in some inaccessible spot which might later cause trouble. It is usually possible to show a savings in the over-all picture by including additional wiring panels to prevent such overloading. A design in which the parts are poorly placed and the wiring is inaccessible not only is difficult to produce but is equally difficult to test or repair. It should be remembered that testing and repairs require skilled labor which is relatively expensive; in fact is is sometimes advantageous to include test jacks or clips in the design to shorten the testing or repair time. Off-hand such a procedure may appear to be an unnecessary expense but in many cases it can be shown to be an actual saving and therefore the possibility should be investigated.

Because of the numerous new developments in materials and methods of fabricating parts, past experience cannot always be relied upon. For this reason in the electrical design, as in the mechanical design, careful cost analysis is the key to savings.

Having discussed the material cost, the next logical item would be labor cost. The design engineer, however, has little to do with this part of the product cost. He can perhaps consult with factory representatives during the development program in an effort to anticipate, if possible, any difficulties likely to be experienced with a particular design. In this way it is sometimes possible to design around these anticipated obstacles and thereby effect a saving. Obviously any simplification in design, which results in less man-hours being required to produce a unit, is a contribution well worth while.

Overhead

Overhead, like labor, does not particularly concern the design engineer since this is a management problem. He is indirectly concerned, however, when it affects the number of engineers available for an assignment. The efficiency with which the engineering development is carried on with the assigned personnel might be considered as the engineer's part in keeping overhead expenses down. To this end a program having an established design procedure with provisions for regular reports on the progress of each development can be instituted.

These records or reports should be circulated to all interested engineers on a given project. Such a procedure will often save valuable time by eliminating any duplication of effort. Unnecessary records or "red tape," however, should obviously be avoided as they are time consuming and have little place in an efficient organization.

Another item that affects the efficiency of an engineering organization is the changing or revising of specifications after the design has been completed. Proper planning and careful engineering should result in a minimum of such changes.

Still another way of decreasing cost is to design the product in such a way that a minimum number of different machines and tools are required. Extra machines require additional setup time and maintenance, and extra tools likewise require additional man hours to produce; both of which add to the piece price of the unit. The saving through standardization of parts is, of course, well known to every engineer and the advantage of eliminating "special" components needs little discussion. It is obvious that the supplier can reduce his cost by larger production and the manufacturer by the elimination of extra drawings, extra ordering and stocking.

Considering all these factors it is evident that the cost of a product can be reduced by eliminating unnecessary overhead expenses.

From the above discussion it can be seen that decreased cost results not only from careful planning of the original design, but also by giving strict attention to many small details throughout the entire manufacturing process.

NEWS BRIEFS

MARKETING SERVICE FORMED

To enable small or average inventors to know, by some other way than trial and error, whether their ideas are acceptable from a manufacturing and merchandising point of view, a marketing service for new inventions has been set up by the firm of *National Merchandisers.*

"The purpose of the new division," according to E. Millard Smith, executive director, "will be to help the inventor at every step, from the beginning of his idea until the invention has been properly developed for manufacturing operations, or is on the market as a finished device or article."

National Merchandisers employs experienced market investigators, industrial and design engineers and merchandising men to contact manufacturers, jobbers, dealers and consumers to determine market needs, while patent and general legal counsel are retained to see that the inventor's interests are surrounded with proper legal safeguards.

Inventions which fail to stand up under investigation are ruled out and returned to their owners. Those which show promise mechanically or commercially are called to the attention of logical users and buyers, who thereafter negotiate either directly or indirectly with the inventors.

An outline of the firm's methods is described in a new booklet, "A 12-Point Program for Inventors," obtainable by writing *National Merchandisers,* 28 E. Huron St., Chicago 11, Ill.

DR. BAKER HEADS I.R.E.

Dr. W. R. G. Baker, vice-president of *General Electric Co.* in charge of the Electronics Department, will serve as president of the Institute of Radio Engineers for the ensuing year as a result of a recent election.

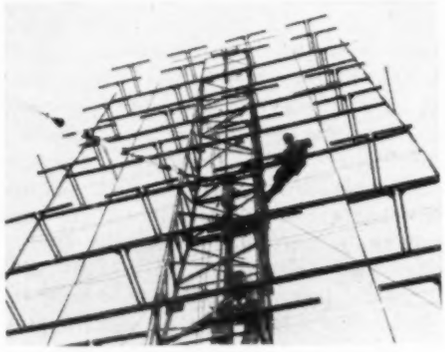
Succeeding Frederick B. Llewellyn of *Bell Telephone Laboratories* to the office, Dr. Baker holds several other important posts, including director of the Engineering Department of the Radio Manufacturers Assn., member of the Board of Governors of the National Electrical Manufacturers Assn. and chairman of the Electronics Committee of the American Institute of Electrical Engineers.

Since 1941 he has been in charge of *General Electric's* Electronics Department with headquarters at Syracuse, N. Y., where a new $20,000,000 plant will soon house the administrative and main production units of the department.

He holds bachelor's and master's degrees in electrical engineering from Union College, as well as the honorary degree of Doctor of Science, conferred by the college in 1935.

RADAR ANTENNA CONVERTED

To conduct experiments in the propagation of radio waves in conjunction with the Federal Communications Commission, WOR has erected an army radar antenna 500 feet above New York's street level on the roof of 444 Madison Ave., the building



which houses WOR's FM station, WBAM.

Transmitting over the old and new FM bands, 47.1 and 106.5 megacycles, respectively, the radar antenna is being used to test radio waves for stability, as well as the effects of weather, cosmic storms, magnetic storms, sun spots and seasonal changes on the various bands.

Erected above the 43rd story, and beamed directly toward Washington, D. C., the antenna is being used at a greater altitude than ever before, and its use effectively increases transmitting power by 60 times.

NEW FACTORY

Carter Motor Co., Chicago manufacturers of rotary electric power supplies for radio communications equipment, recently moved into enlarged quarters at 2644 N. Maplewood Ave., with over four times their previous floor area.

Steadily increasing demands for the company's products, including dynamotors, magmotors, genemotors and rotary converters, necessitated the change, according to Robert Carter, president. In great demand through-

out the war, the equipment is now being used in aircraft, marine, railroad and police communications.

An illustrated catalog of the company's products has been prepared and is available through the manufacturer.

SCIENCE AWARD

General David Sarnoff, president of *RCA,* has been selected for the *Science Illustrated* "Man of Science" award granted by *McGraw-Hill Company,* publishers of the magazine. General Sarnoff is also marking his fortieth anniversary of his entry into radio.

The award is the first of the new science awards to be made by the magazine to men who have "by their exceptional talents used science for the advancement of industry and culture."

General Sarnoff's award is based on his tremendous contributions in building the radio industry, and in particular for his vision and imagination in developing research as a keystone of the *Radio Corporation of America.* He is also a leader in the educational and cultural use of radio, the award states, and his efforts to maintain radio on a high level of service is an indication of his worth as a leading "Man of Science."

PHILIPS WIRE DIV. MOVES

North American Philips Company, Inc. recently moved its Wire Division

from Dobbs Ferry, New York to Lewiston.

The plant at Lewiston was formerly used to manufacture tungsten and molybdenum products in connection with the company's war production of

electronic tubes and other products. The Lewiston plant will specialize in the drawing, enamelling and plating of wires of extremely fine size in practically all metals and alloys. A new addition, approximately doubling the floor area, has been erected to house the added production operations. The photograph shows the Lewiston plant from the air.

FISHING FLEET BUYS RADAR

To avoid inter-vessel collisions and to permit ships to work closer together without danger despite their "blindness" in the fog-bound waters of Newfoundland's Grand Banks, an American-built marine radar unit has been purchased for test installations in the French fishing fleet.

Westinghouse Electric International Co., which sold the equipment to the French Supply Council, has installed a similar unit for commercial use in Chesapeake Bay, where it guards the *Old Bay Line's* night boat, City of Richmond, on nightly runs between Baltimore and Norfolk.

An experimental unit is in operation on the William G. Mather, flagship of the Great Lakes shipping fleet of the *Cleveland Cliffs Iron Co.,* one of six such installations on Great Lakes vessels for tests being conducted by the Lakes Carriers Assn.

The unit incorporates up-to-the-minute refinements of the war-born development and will provide navigational and anti-collision protection in darkness, fog and all varieties of bad weather from 100 yards to 32 miles. Of the continuous plan position indicator type, the radar picture is shown on the face of a 7-inch cathode ray tube mounted in a small cabinet convenient to the watch officer's station on the bridge. Readings may be taken at three ranges—on a radius of 2, 8 and 32 miles.

H.F. PERMIT GRANTED

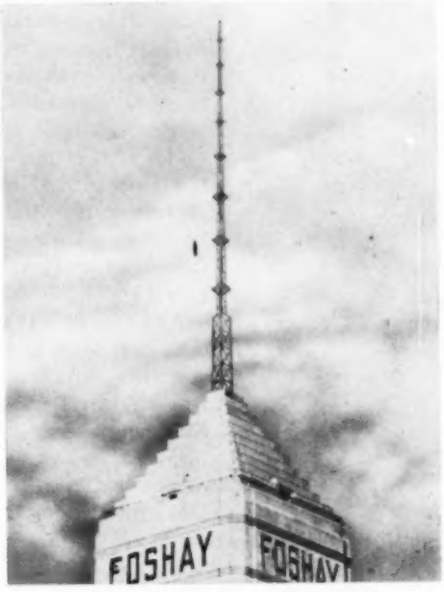
The *Kellogg Switchboard and Supply Company,* Chicago, was recently granted a construction permit for a Class 1 experimental high-frequency station by the Federal Communications Commission.

In presenting its construction permit application, the *Kellogg Company* stated that the firm was seeking portable and portable-mobile stations using frequencies in the 30-40 megacycle band and 152-158 megacycle band with 30 watt power and for emission A0, A1 and special FM and tone emission. The company's particular interest in its new experimental high-frequency station is in the extension or improvement of communication facilities of telephone companies, fire and police departments, transit utilities, railroad companies, and other concerns rendering public communications services.

Forthcoming experiments with the new *Kellogg-Philco* high-frequency station will include studies of selective calling systems, efficiency of different antenna designs under conditions of varying terrain and antenna designs for use in areas containing physical and/or electrical obstruction to v.h.f. radio signals. Other experimental work will include a search for some means of correlating radio transmission and reception with the wire facilities of telephone companies.

SQUARE LOOP ANTENNA

The photograph below shows how Foshay Tower in Minneapolis, Minnesota, is to look when topped with an 8-element square loop FM antenna, which is manufactured by *Federal Telephone and Radio Corp.* The antenna was manufactured for radio station WTCN of the *Minneapolis Broadcasting Company.* This station will go on the air with a 3 kw. FM transmitter, also manufactured by *Federal.*



ALUMINUM WIRE

Due to the current copper shortage, the *United States Rubber Company* announced recently that it will substitute aluminum for copper in some of its building wire and cable now going into production.

The insulated aluminum wire will be made in all sizes, as approved by Underwriters' Laboratories. Aluminum has high electrical conductivity, light weight, and adequate flexibility, according to H. H. Weber, sales manager of the company's wire and cable department. He also stated that the company has developed aluminum wire with the same over-all diameter as equivalent copper sizes.

CALENDAR of Coming Events

JANUARY

27-31 inc.—**Electrical Engineering Exposition,** 17th Regiment Armory, Park Avenue and 34th St., New York. This Exposition will be held concurrently with the Winter Convention meeting of the America Institute of Electrical Engineers.

MARCH

3-6, inc.—**I.R.E. Convention and Radio Engineering Show,** Grand Central Palace, New York City, with headquarters at the Commodore Hotel. In addition to the technical sessions, there will be a display of radio-electronic engineering equipment said to be the largest and most interesting ever assembled on one floor.

APRIL

19—**Chicago I.R.E. Conference,** Continental Hotel.

MAY

11-16, incl.—**National Radio Parts and Equipment Show,** Stevens Hotel, Chicago.

* * *

MONTHLY MEETINGS

Institute of Radio Engineers, Chicago Section. Don Haines, Secretary, CAPitol 6500.

Dinner 5:45 P.M., Electric Club 38th floor, Civic Opera Building. Program 7:00 P.M., 6th floor, Civic Opera Building, 20 N. Wacker Drive.

January 17—Vibrator Power Supplies, by John Weber, *Oak Manufacturing Co.* and New U.H.F. Measuring Techniques, by E. G. Hill, *Belmont Radio.*

* * *

American Institute of Electrical Engineers, Chicago Section. J. E. Hobson, Secretary, 35 W. 33rd St., Chicago 16, VICtory 3300.

Supper, Ford Hopkins Cafeteria, 3rd floor, Civic Opera Building. Food served from 5:30 to 6:15 P.M.; no reservations required. Program, 7:00 P.M., 6th floor, Civic Opera Building, 20 N. Wacker Drive.

January 9—Industrial Group.

January 16—Communications Group —FM Carrier Telegraphy Systems, by F. B. Bramhall, Transmission Research Engineer, *Western Union Telegraph Co.*

January 23—Power Group.

NEW TUBES

HIGH-VACUUM PHOTOTUBE

The 1P42 is one of four new electron tubes which the Tube Department of the *Radio Corporation of America* recently announced.

A very small "head-on" type of high-vacuum phototube, it is designed par-

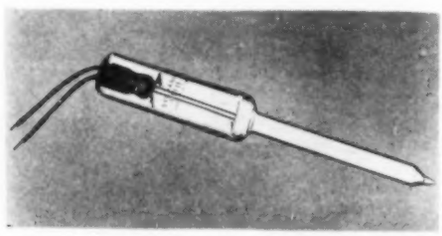
ticularly for control purposes in applications where space limitation is a prime consideration. Its diameter of only ¼" facilitates close spacing in banks for the control of a large number of circuits.

The semi-transparent cathode surface on the glass window in the large end of the 1P42 is sensitive to light sources predominating in blue radiation.

The other new tubes are 3C33, a twin-triode power amplifier for control applications, and 12AU7 and 35B5, additions to the *RCA* miniature tube family so widely used in the design of radio and television receivers.

PIRANI TUBES

Suitable for pressure gages and leak detectors in evacuating apparatus and automatic pressure recording equipment, Pirani tubes are avail-



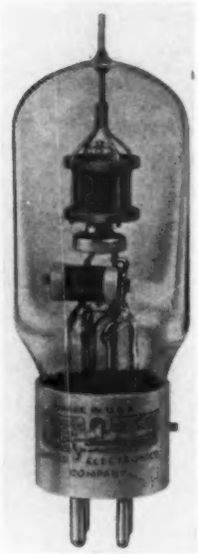
able from the Electronics Division, *Sylvania Electric Products, Inc.*, 500 Fifth Ave., New York 18, N. Y.

The tubes are designed with special tungsten filaments having a high temperature coefficient of resistance permitting direct readings of gas pressures. Change in gas pressure produces a change in thermal conductivity, filament temperature and filament resistance. Measurement of filament resistance, calibrated in terms of pressures for individual gases, is indicated on an 0-1 milliammeter place in a simple bridge circuit.

GRAPHITE ANODE TUBE

A new compact and powerful graphite anode beam tetrode, Type 5562, is being produced by the *United Electronics Co.* for the v.h.f. bands of the amateur, aeronautical, mobile and emergency services.

Conservatively rated at 175 watts input up to 120 megacycles, the new tetrode has low drive characteristics, from 2 to 4.5 watts dependent upon plate input, frequency and class of operation.



The tube contains the new *United* isolated getter trap which keeps tubes free from gas and preserves filament emission. The emission and gas content qualities revealed in Type 5562 have been found to be far superior to tantalum and other comparable metal anode tubes.

Further information can be obtained from *United Electronics Co.*, 42 Spring St., Newark 2, N. J.

HYTRON IONIC-FLASH TUBE

Allowing even the amateur photographer to take ultra-rapid, arrested-motion stills with an ordinary camera, the *Hytron* type HD72 tube, designed for photographic flash equipment, is being produced by *Hytron Radio and Electronics Corp.* of Salem, Mass.

The HD72 may also be used in beacons, obstruction markers, airport boundary markers and signaling devices. Each tube gives a minimum of 25,000 flashes.

In a typical circuit, the tube is controlled by a relay connected to the synchronizer. When the associated relay is closed, in less than 1/50,000 second the HD72 discharges through its internal glass coil, filled with xenon gas, the electrical energy stored in the high-voltage condensers. Color quality of the resulting ionic flash, approximately that of normal daylight, is excellent for color film.

FIVE KW. MAGNETRON

A new magnetron, furnishing 5 kw. of continuous power output and designed for use as a c.w. oscillator, is expected by *General Electric Co.* to

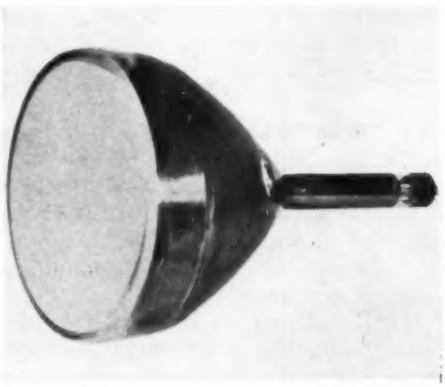
prove useful in many plastics and other industrial heating applications since it will permit heating in a cavity or enclosure constructed with good electrical conducting walls.

Produced by the Tube Division of *GE's* Electronics Department, the magnetron operates at 1050 megacycles and is believed to furnish more continuous power than any other of its type. It may be plugged into a circuit with one operation.

Designed with all-metal construction, the tube has a range of efficiency of 60-65% at maximum power output. Its cathode terminals and water connections may be turned in any direction. The anode is water-cooled while the cathode is a pure tungsten filament.

CATHODE-RAY TUBE

The *Rauland Corporation* is now manufacturing a new Visitron 10", virtually flat face direct-viewing cathode-ray tube, Type R-6025. The electro-



magnetic focusing and deflection method employed allows the screen to be excited by a relatively high beam current, insuring good contrast with excellent focus. This new Visitron tube has a screen with characteristics especially adapted to television reception.

Complete details on this tube may be obtained by writing to the *Rauland Corporation*, Chicago 41.

New Products

(*Continued from page* 21)

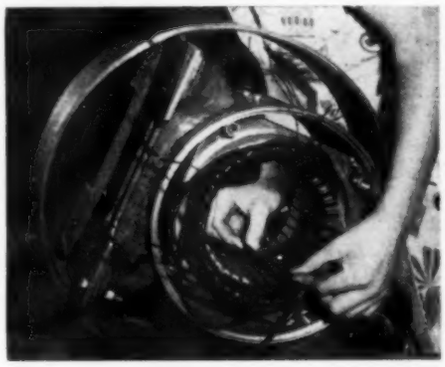
calibrating other microphones and contact microphones for picking up vibrations in solids.

Massa Laboratories, Inc., 3868 Carnegie Ave., Cleveland, O., will supply further information.

ALL-STEEL MOTOR

A new alternating-current motor, known as the Life-Line, and more than 35 per-cent smaller in size than its predecessor has been developed by *Westinghouse Electric Corp.*

The reduced size has been accomplished without sacrifice of electrical properties. Starting torques have been increased as much as 134 per-cent per pound of motor and maximum torques increased as much as 116 per-cent per pound of motor. It is stated that the bearings will need no attention for at least five years. Shock resistance is increased many-fold. This motor is a result of intensive engineering development and research, based on years of experience and the use of new materials, new methods, new



processes and new tools. A new factory has been purchased for its production.

The photograph above shows a partially wound stator. Coils are being placed preparatory to sealing the slot cell. Seal is made with a wooden wedge. A half-round groove in the underside of the wedge laps the projecting edges of the slot cell insulation together, thereby insuring electrical and mechanical protection to the synthetic resin insulated copper wire coils. The circular frame supporting the stator being wound enables the operator to rotate it vertically or to turn it horizontally as easily as dialing a phone.

THERMOSETTING RESIN

Significant improvements in the properties of DC 2103, the thermosetting silicone resin developed and produced by *Dow Corning Corp.*, have been announced.

Used as an heat-stable bonding material for inorganic fabrics in the production of rigid electrical laminates, and for bonding finely divided particles such as powered metals or mica, silica or carbon, DC 2103 is unique among thermosetting resins for its high heat stability, very low water absorption, excellent dielectric properties over a wide frequency range and for its resistance to carbon tracking.

Additional information is available through *Dow Corning Corp.*, Midland, Mich.

"HI" LIVE CENTERS

The use of carbide tipped tools, which has made possible higher machining speeds, requires live centers

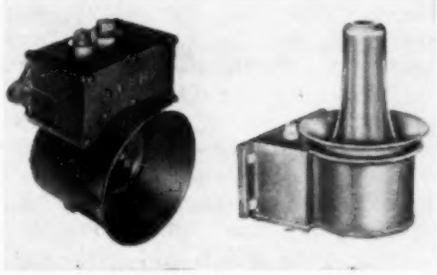
which eliminate friction in the head and tailstock. *Holub Industries, Inc.* recently introduced a new line of "Hi" Live Centers which incorporate the latest engineering precision and design to handle heavier loads at the higher speeds. These live centers are equipped with matched and preloaded *Timken* bearings.

The new design assures accuracy—eccentricity or run-out of point is held to .0002", both free and under load. Since the bearings are preloaded, there is no chattering and internal bearing play is eliminated. They also offer high load carrying capacity up to 1,000 pounds in the No. 2 and 3 Morse Taper sizes and up to 2,400 pounds in the No. 4 and 5 Morse Taper sizes. Another improvement is a heavy duty "grease seal" which resists wear from metal chips and prevents the entrance of foreign matter.

Complete details on these "Hi" Live Centers may be obtained by writing directly to the *Holub Industries, Inc.*, Sycamore, Illinois.

NEW LOUDSPEAKERS

The *University Loudspeaker, Inc.* recently announced the development of two new submergence and explosion



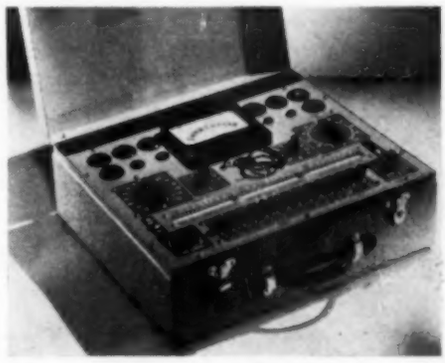
proof speakers. Both speakers are built entirely of rugged aluminum castings and equipped with Alnico V permanent magnet dynamic driver units. The model MSR consists of a reflex air column horn, a radial deflector for 360° dispersion, and a hermetically sealed housing with a special built-in high efficiency driver unit. The housing also provides mounting facilities for a constant-impedance attenuator and a line matching transformer if either or both are needed.

The model MM-2TC is a directional speaker consisting of a reflex air column horn and a hermetically sealed housing with a special built-in high capacity driver unit. In the lower section of the housing, space is provided for an attenuator or transformer as required. Both models, MSR and MM-2TC, will function under water. They will drain automatically in their operating position, and provide uninterrupted service with a minimum of maintenance. Consistent operation is assured regardless of salt spray or extreme weather on docks, open bridges, boiler rooms, or any part of a ship or harbor installation. They are also immune to coal dust and steam.

Complete technical details may be obtained by writing direct to the *University Loudspeakers, Inc.*, 225 Varick Street, New York 14, N. Y.

TUBE TESTERS

Two new electron tube testers suitable for all standard receiving and several special types of tubes have



been announced by the Radio Tube Division of *Sylvania Electric Products, Inc.* These testers are said to combine many of the company's developments for production tube testing and provide approximately 80 per-cent of the accuracy available in commercial tube production equipment. The new instruments, a counter type 139 and a portable type 140, provide tube testing facility for shop, spot testing in the home, industrial electronic applications, automobile and mobile radio equipments. The testers may also be used to check receiving type tubes used in broadcast receivers, FM, television, industrial electronic controls, record players, and photoelectric devices under dynamic conditions and without damage to tubes.

The instruments were designed to include extra sockets and switch con-

tacts for modernization as new types of tubes are developed. Both types are supplied for 105-125 volts, 50-60 cycle a.c. operation.

FLASHLIGHT BATTERY

The new "Eveready" high energy battery, just introduced by *National Carbon Company, Inc.*, doubles the capacity of former ones. The battery is said to provide longer playing time per power unit for small personal radios, longer life in flashlights, and very high capacity even when carried on the shelf for extended periods of time.

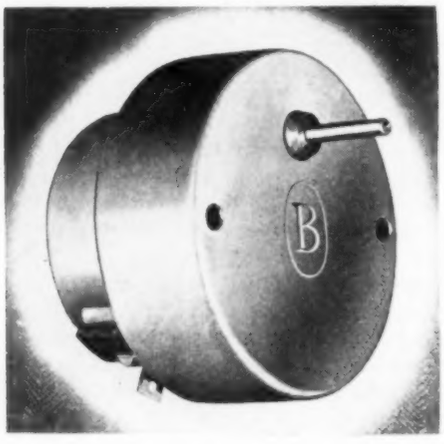
War experience was responsible for several of the design improvements, since information gained in developing a superior chemical mix for cells used in VT proximity fuses of artillery and anti-aircraft shells has been applied to double the capacity of the new flashlight battery. One important factor is a change in the charge of chemicals inside the new battery.

TIMING MOTOR

The Circle B, a new timing motor that incorporates several important advances in design, has been announced by the *A. W. Haydon Co.*

Exceptionally compact, the Circle B timing motor easily fits in a two inch circle. Among other features of the motor are: through holes for mounting, easy-to-solder terminals, no straggly lead wires, and there are no ears sticking out. Production of the new motor will be limited initially to 1 and 5 r.p.m. speeds. Other speeds available are: 110, 220, and 24—all at 60 cycles.

The motor was designed by the *A. W. Haydon Company* and is being manu-



factured by the *Bristol Machine Tool Company*. Complete information may be obtained by writing directly to the *A. W. Haydon Co.*, Dept. P, Waterbury, Connecticut.

TEFLON PLASTIC

An answer to many long-standing insulation problems in electrical equipment is Teflon, a new *Du Pont* plastic which is unharmed by temperatures up to 575 degrees F. and withstands every known solvent.

Tetrafluoroethylene resin, it is described as an excellent material for the ultra-high frequencies required by radar and television, having an extremely low dielectric loss factor, even at frequencies up to 3,000 megacycles. It does not dissipate the electrical power as do most organic insulators when subjected to h.f. currents.

Surpassing polystyrene and polythene, both with favorable electrical properties, Teflon is already being used for a variety of electrical insulators and related parts, and thin tapes of Teflon are being tested as primary insulations and as a material for slot liners.

Films of the plastic may be flexed without cracking at temperatures as low as —100 degrees C., and its water absorption rate is rated "zero." High impact strength and toughness are among its other properties.

Disc Recordings

(*Continued from page* 6)

number of turns on the coil and ϕ is the magnetic flux. Initially a means must be found to obtain a changing flux adhering rigorously to the relationship $\phi = K_1 X$, where K_1 is a design constant and X is the stylus displacement. This requires that with motion of the stylus in accordance with $X = X_0 \sin \omega t$ where X_0 is the peak stylus displacement

$$\frac{d\phi}{dt} = \omega X_0 \cos \omega t$$

so that the output voltage is

$$E = K_2 N \omega X_0 \cos \omega t.$$

Having accomplished this not inconsiderable initial task, it is necessary to design the mechanical structures of the pickup in such a way that the motion of the reproducing stylus point will duplicate the motion of the cutting stylus. The success of this procedure is based on the assumption that the cutter functioned to produce an instantaneous cutting stylus displacement rigorously proportional to the instantaneous current driving mechanism. Failure to trace the groove properly produces distortion which is largely a function of the velocity angle and the stylus point radius. Thus, where V_R is the linear groove velocity past the stylus and the velocity angle $\alpha = \tan^{-1} \omega t = 30°$, it becomes extremely difficult to design a mechanism that will properly trace the groove.

The vibrating system of the pickup is, of course, actually moved by forces exerted by the record walls. The conditions may be expressed by the equation

$$F = M \frac{d^2x}{dt^2} + R \frac{dx}{dt} + \delta x \quad \ldots\ldots\ldots\ldots (1)$$

where F is the lateral force on the

Fig. 14. Close-up view of the G-E variable reluctance pickup.

stylus, M is the effective mass of the vibrating system, R is the damping force, S is the stiffness, and stylus displacement is represented by X. The design premise stated that

$$\frac{dx}{dt} = \omega x \cos \omega t,$$

$$\text{and since } \frac{d^2x}{dt^2} = -\omega^2 x \sin \varepsilon t,$$

the first two terms have no significance at low frequencies if the mechanical resonance (where the first and third terms cancel and leave only the damping force) occurs in the mid-frequency region. At high frequencies the last term loses importance and the mass reactance is the dominating force.

The force applied to the stylus may be resolved into lateral and vertical components. The vertical component is opposed by the stylus pressure. Where the armature support has vertical compliance, the force is applied through this support in series with the armature mass. If the vertical force exceeds the tracking pressure, the stylus will be driven out of contact with the groove. This results in complex resonant wave forms. The audible effect is aptly described as "chatter." Proper tracking requires that the stylus pressure exceed the sum of the lateral forces on the stylus point. The reaction on the groove walls will always be less than the stylus pressure if the conditions for perfect tracking are fulfilled. If this figure is kept below 15 grams, the usual record wear resulting from forces exceeding the elastic limits of the groove walls will be eliminated.

Appreciation is expressed for material contributed by Mr. Norman C. Pickering, *Pickering & Co., Inc.*, Oceanside, New York.

REFERENCE

1. *Goodell, John D., "The Reproduction of Disc Recordings," Radio-Electronic Engineering edition of Radio News, November, 1946.*

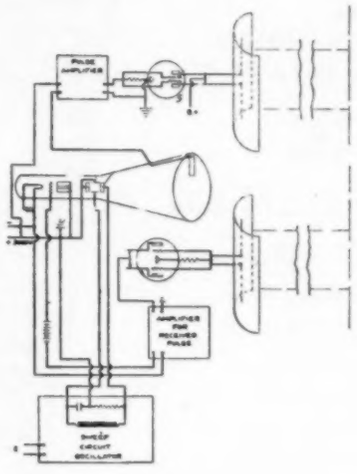
COMPLETE INDEX
RADIO-ELECTRONIC ENGINEERING EDITION OF RADIO NEWS

VOLS. 1-7 Incl.
July, 1943, Through December, 1946

PATENTS

METHOD AND MEANS FOR DISTANCE DIRECTION FINDING

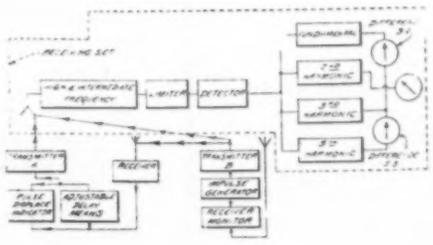
Means for measuring distance by means of electromagnetic waves which comprises means for transmitting high frequency electromagnetic waves of approximately one meter, means for



controlling the emission of said electromagnetic waves at definite time intervals including an electron beam, means for receiving said impulses after reflection from the surface whose distance is to be measured, means for causing the received impulse momentarily to deflect the course of said electron beam and means cooperating with the momentarily deflected beam for producing an indication of the distance from said surface. Robert W. Hart, assigned to *Submarine Signal Company.* Filed March 5, 1935, granted September 10, 1946. No. 2,407,273.

COURSE BEACON

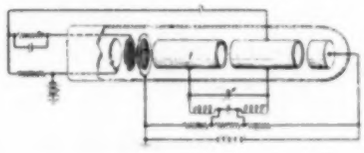
The method of guiding a mobile unit by signals from a plurality of fixed spaced antennas which comprises generating energy in a periodically



recurrent series of relatively short impulses, dividing such energy into a plurality of similar portions, introducing a relative delay between corresponding impulses in said portions, transmitting from each of said antennas energy from one of said portions, simultaneously receiving energy radiated by each of said antennas, filtering said received energy into individual odd-multiple frequencies of said periodical recurrence, and obtaining and indication of the relative magnitudes of the energy of two of said odd-multiple frequencies. Emile Labin, assigned to *Federal Telephone & Radio Corp.* Filed June 28, 1941, granted September 10, 1946. No. 2,407,287.

ELECTRON DISCHARGE APPARATUS

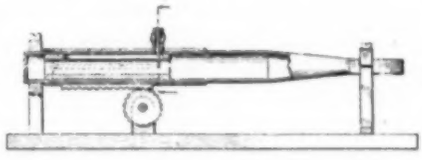
The method of generating electrical oscillations which comprises producing a stream of electrons, accelerating the electron stream, successively increasing the potential of the electrons in said stream in a pair of regions traversed thereby while maintaining the velocity of said electrons substantially constant, extracting energy from said stream alternately at said regions, and feeding back a portion of the en-



ergy thus extracted to said stream adjacent the region of acceleration thereof. Albert M. Skellett, assigned to *Bell Telephone Laboratories, Inc.* Filed October 11, 1941, granted September 10, 1946. No. 2,407,297.

ULTRA-HIGH FREQUENCY ATTENUATOR

An ultra-high frequency device comprising an elongated hollow conductive



member, conductive means extending along said member for reducing the cross-section thereof, high frequency energy coupling means at a predetermined point of said member, further high frequency coupling means coupled to said conductive means, and means for longitudinally adjusting said further coupling means and said conductive means relative to one another. Edward L. Ginzton, assigned to *Sperry Gyroscope Company, Inc.* Filed March 5, 1943, granted September 10, 1946. No. 2,407,267.

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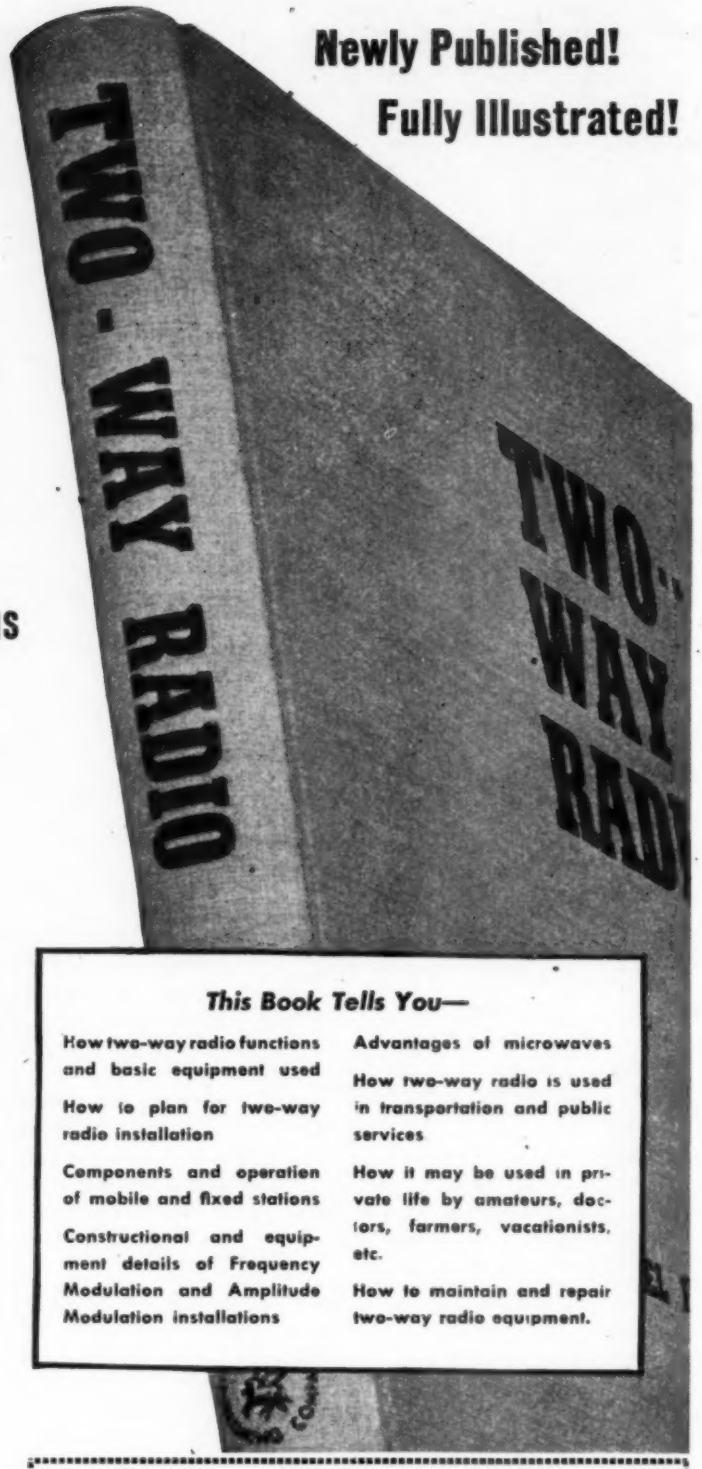

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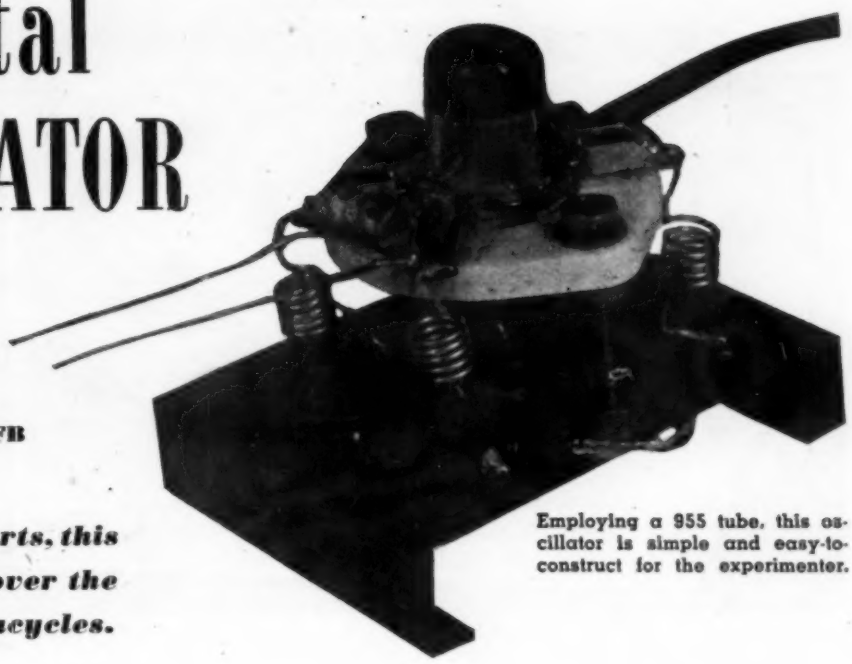
Experimental U.H.F. OSCILLATOR



Employing a 955 tube, this oscillator is simple and easy-to-construct for the experimenter.

By C. W. ROESCHKE, W9PFB

Constructed from available parts, this simple u.h.f. oscillator will cover the range from 400 to 800 megacycles.

HERE is a u.h.f. oscillator which can be constructed in an hour without the assistance of a plumber or a machinist. It consists of a very few components, most of which can be made by hand in a few minutes.

Fig. 1 shows the circuit diagram of the 400 to 800 mc. oscillator. The frequency of this oscillator depends on the position of condenser, C_1, along the line L_1. This circuit is based on D. B. Sinclair's development described in his article entitled "High Frequency Measurements." This article originally appeared in the January, 1946, issue of the RADIO-ELECTRONIC ENGINEERING edition of RADIO NEWS.

Fig. 2A shows how the r.f. chokes (*RFC*) are made. All four are identical and consist of 5 turns of No. 22 wire with 3/16" inside diameter and a winding length of 9/32" or 5/16".

Fig. 2B describes the construction of the feed-through condenser. It is necessary to use this type of condenser because "postage stamp" type mica condensers frequently introduce too much inductance in the circuits. Of course, commercially manufactured feed-through condensers may be used and the required capacity would be about 50 $\mu\mu$fd. As shown in the drawing, the feed-through condenser is made up of the following parts: (A) 6-32 x ½" screw, (B) lockwasher, (C) solder lugs, (D) copper washers, 1/16" thick x ¾" diameter, with a 3/16" hole in center, (E) mica washers, .010" thick x ⅞" diameter, with 3/16" hole in center, (F) spaghetti sleeving 3/16" long to fit over screw, (G) plain washer, (H) 6-32 nut.

As can be seen in the photograph, the r.f. chokes are mounted in a perpendicular position. They project straight down from the tube terminals to the chassis. This is important as leads must be short. The tube socket is only ¾" above the chassis.

The dimensions and mechanical layout for constructing the chassis are shown in Fig. 4.

A common lead for "A—" and "B—" is soldered to the chassis near the point where the grid resistor is also grounded.

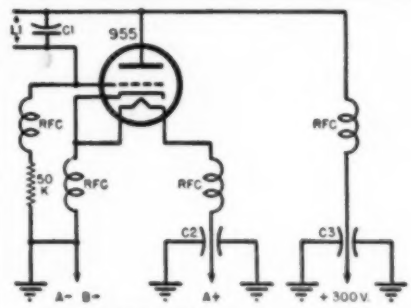
Leads on the ceramic condenser are about ⅛" long and the condenser is soldered across the parallel lines. Tinned wire of size No. 20 is used to make the tuned line, L_1, which is connected between plate and grid of the tube. The line is 2½" long with a ⅜" spacing between the wires.

Filament voltage can be 6 volts, either a.c. or d.c.

300 volts d.c. should be used on the plate as the circuit will not oscillate dependably if a voltage of much lower value is employed.

First apply filament voltage and allow the tube to heat. Then apply plate voltage and the circuit will oscillate. It is as simple as that. There

(*Continued on page* 116)



C_1—*50-100 $\mu\mu$fd. ceramic cond.*
C_2, C_3—*Feed-through cond. (See text)*
L_1—*Tuned line (See text)*
RFC—R.f. chokes (See text)

Fig. 1

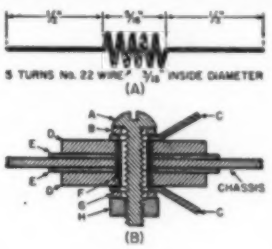


Fig. 2

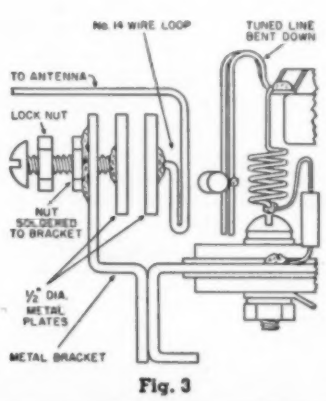


Fig. 3

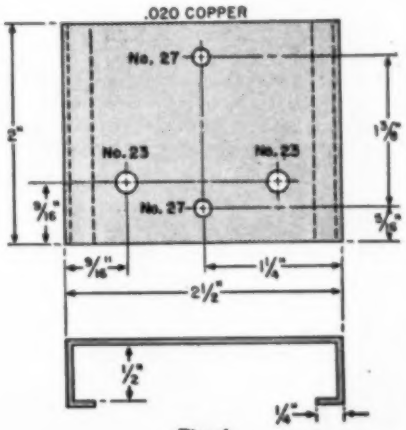


Fig. 4

Fig. 1. Both visual and aural indications are provided in this battery-operated test unit.

A New All-Purpose SIGNAL TRACER

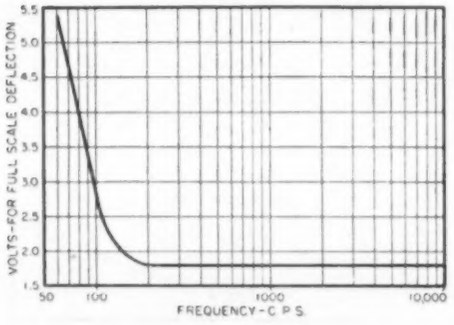
By SHEPHARD LITT

Design Eng., Superior Instruments Co.

Construction details of a commercially built test instrument. Radio receiver faults can be quickly and accurately located with this signal tracer.

FOR some time now it has been generally conceded by progressive radio servicemen that the principle of signal tracing is, in general, the simplest and most direct approach to the problem of diagnosing the defects in radio receivers. The reason for this is that the signal tracing method makes use of the most fundamental factor in any type of electronic system—the signal itself. Guessing at the trouble, on the basis of previous experience with similar difficulties, is unreliable and does not keep pace with the continued development in communication circuits. The point-by-point system of static voltage and current measurement by means of a multirange volt-ohm-milliammeter is very slow and not completely dependable, since any number of defects may exist in the system without in any way altering the operating potentials or d.c. resistance values. The method of signal tracing, by which a signal is applied to the input and traced stage-by-stage through the receiver under operating conditions, offers the advantages of superior speed, universal application, and positive identification of the defects.

Fig. 2. Audio frequency response of the v.t.v.m. showing the voltage required for full-scale deflection.



The only major objections now raised against the use of signal tracing in the servicing of receivers concern the amount of equipment which must be carried, and the possible adverse psychological effect which may be given to the customer by the radio serviceman who needs a considerable amount of test equipment to diagnose what may be a simple defect in the receiver. The merit of this criticism is evidenced by the continual simplification in the design and construction of signal tracers. In the research laboratory, signal tracing in newly designed equipment is generally performed by the use of the vacuum tube voltmeter, the oscilloscope, and the distortion meter. It would obviously be ridiculous for a radio repairman to carry all this equipment into a customer's living room to diagnose the trouble in a radio receiver. Furthermore, the average repairman does not like to use an oscilloscope, and has no need for a distortion meter. He would prefer to listen to the audio signal for quality and distortion rather than see it on the screen of an oscilloscope or on a distortion meter. Signal tracers for radio receiver servicing therefore have become small, compact, easily portable instruments performing one or more functions to simplify as much as possible the tracing of the signal through every section of the receiver.

The signal tracer described in this article is an improved model which provides an r.f., i.f. and a.f. vacuum tube voltmeter, and at the same time offers an audible check of the signal quality by means of a loudspeaker or earphones, thus permitting maximum flexibility with increased sensitivity. With the use of this signal tracer, a volt-ohm-milliammeter and a spare set of good tubes, the faults in a receiver can be rapidly and completely diagnosed (in the customer's home, if necessary) without the use of any additional equipment. It is, of course, desirable to have available a modulated r.f. signal generator and a tube tester when the receiver is being serviced in the shop, but on occasions when work must be done outside of the shop it is a decided advantage to be able to carry as little equipment as possible.

A number of different signal tracers are in general use at the present time, but most of these possess certain limitations either to their application or to their ease of operation. The signal tracer described here possesses a number of decided advantages over other existing instruments of this type:

a. Most of the available instruments possess either aural or visual indication of the signal, but not both. In those which do give both, a 6E5 "magic-eye" electron-ray indicator tube is generally used as the visual indicating element, thus giving either very approximate readings, or necessitating continual setting of a gain control with the closing of the eye as a reference each time an accurate voltage

or gain reading is required. The present equipment provides both a visual indication of relative signal strength by means of a vacuum tube voltmeter (for stage gain and signal level measurements), and an aural indication of signal characteristics and fidelity by means of a high-gain audio amplifier, with an earphone output for greater sensitivity when required.

b. The sensitivity is sufficiently high to indicate the presence or absence of signal in every section of the receiver.

c. Most early signal tracers made use of the diode type vacuum tube voltmeter circuit requiring additional components making a more cumbersome and complex unit. Many models used a tuned r.f. amplifier which, while quite efficient, takes longer to set up and may require constant adjustment. The circuit used in this instrument makes use of a triode grid leak detector which requires no tuning or adjustment in operation.

d. The input impedance of the grid detection circuit used is so high that there is no loading of the circuit under test up to frequencies above 10 mc.

e. The wide frequency range, which extends from low audio frequencies to over 10 mc., makes the instrument useful for measurements on all types of audio circuits, i.f. and r.f. sections of broadcast receivers, audio and i.f. sections of FM receivers, and video amplifiers. This frequency range provides the maximum benefits from the viewpoint of flexibility of operation and simplicity of design, since if the bandwidth were to be extended to accommodate all frequencies which might be required in the future it would be necessary to extend the response to well over 500 mc. to include the high frequency television band in which color television broadcasts are now being transmitted. Such a procedure would obviously be impractical in the design of a test instrument such as this. (If, however, in the future it should become desirable to perform r.f. measurements in FM and low-frequency television receivers, it is a simple matter to construct a v.h.f.-u.h.f. rectifier probe using a 1N34 crystal diode detector whose output would feed into the signal tracer.)

f. The circuit has been designed to provide a maximum of operational flexibility and increased sensitivity, without introducing excess complication by duplicating any functions of any of the other instruments which the serviceman customarily carries along on an outside service call. Thus, there is no provision for the measurement of any d.c. voltages, since they can just as easily be measured by means of the volt-ohm-milliammeter which is invariably present. By designing the instrument to be battery operated, this signal tracer has been made as completely portable as the battery operated volt-ohm-milliammeter.

The schematic circuit diagram of the new signal tracer can be seen in Fig. 4. The circuit consists essentially of a grid leak vacuum tube voltmeter and a single stage of audio amplification. The detector circuit consists of a 1T4 tube connected as a triode, with a .0002 μfd. coupling condenser and a 20 megohm grid resistor. The input impedance of the grid circuit is so high that there is no loading of the circuit under test at any frequencies below 10 mc.

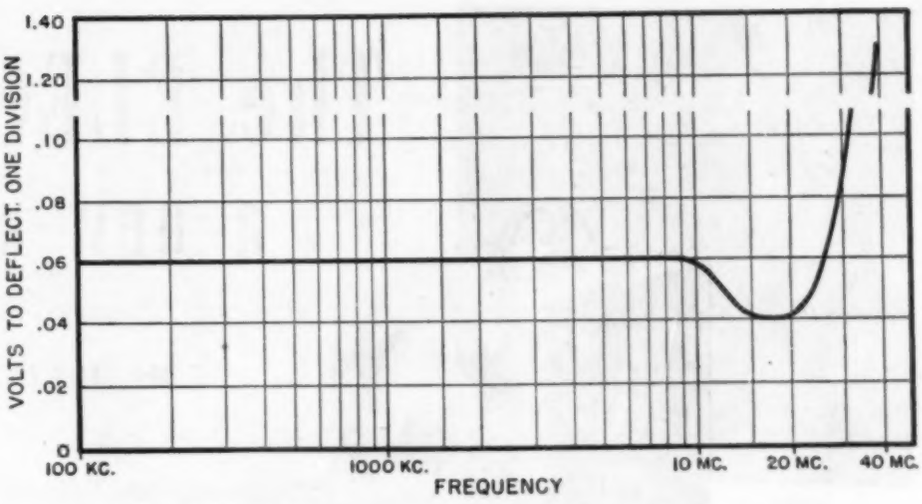


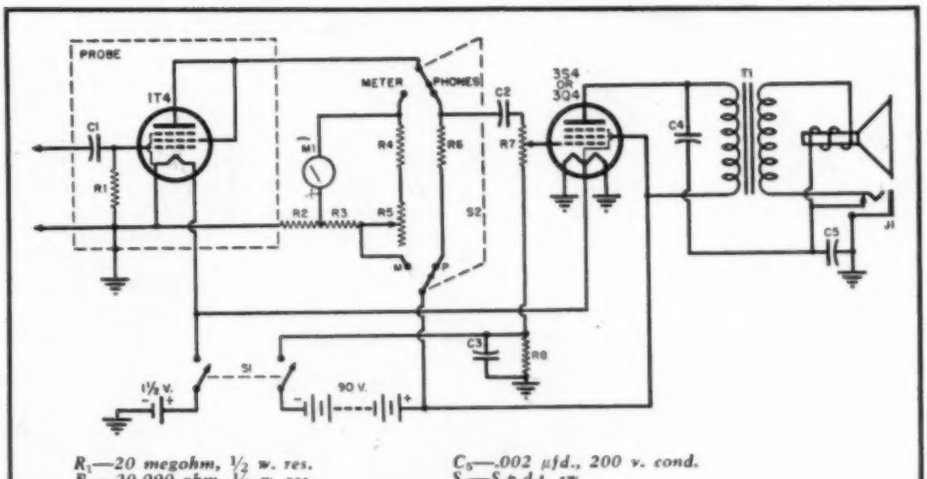
Fig. 3. Curve shows the sensitivity of the probe at radio frequencies.

A switch in the plate circuit provides for operation of the tube as either a vacuum tube voltmeter or an audio amplifier stage. The operation of the vacuum tube voltmeter may be described briefly as follows: When there is no signal applied to the grid, current flows in the plate circuit because there is no bias on the grid. When a signal is applied to the grid, rectification takes place and the current flowing through the grid resistor biases the tube, causing the plate current to drop. In order to make the meter give positive current readings for decreases in tube plate current, the meter is connected in reverse (plus terminal to plate, and minus to B+) and a bucking voltage applied across the meter to bring the reading to zero when there is no signal. Meter current is adjusted to zero for no signal by means of the 500 ohm balancing potentiometer. Then, when a signal is applied to the grid, the meter reads up scale in the conventional manner. It may be mentioned that the calibration is not in volts, but in relative signal strength, and that the meter used in this circuit is the new cobalt magnet type, which is much more rugged for portable use.

With the switch in the *"Speaker"* position, the 1T4 serves as a stage of audio amplification which drives the 3S4 in a high gain stage operating the speaker. An Alnico V speaker is used because of the greater sensitivity it offers. In addition to the speaker, a phone jack is provided for the use of phones when greater sensitivity is required, especially if a weak signal is being checked. The phone jack is of

(*Continued on page* 86)

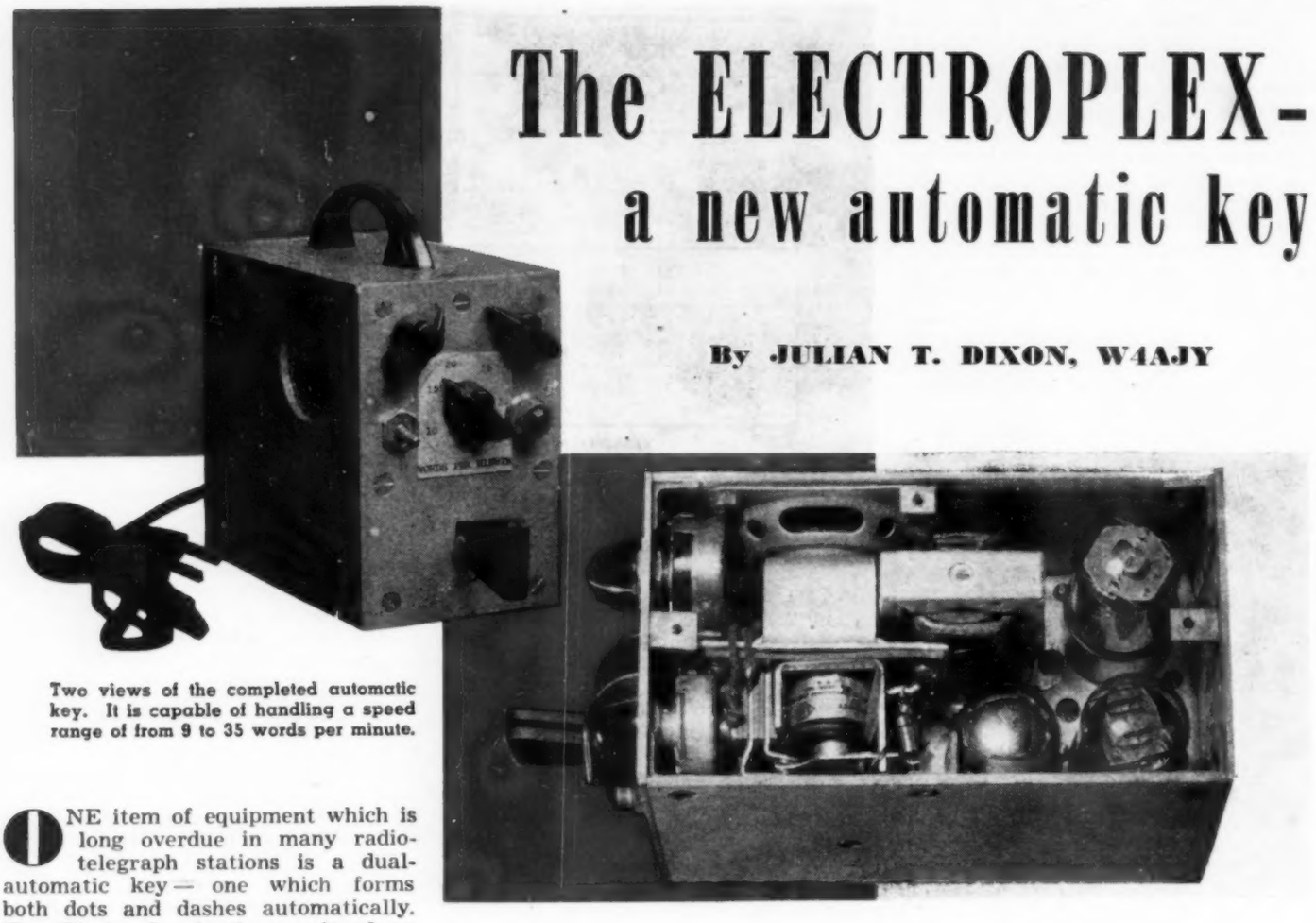
Fig. 4. Schematic diagram of visual-aural signal tracer.



R_1—20 megohm, ½ w. res.
R_2—20,000 ohm, ½ w. res.
R_3—1000 ohm, ½ w. res.
R_4, R_5—500 ohm, ½ w. res.
R_7—500 ohm rheostat
R_6—30,000 ohm, ½ w. res.
R_7—500,000 ohm pot.
C_1—.0002 μfd. mica cond.
C_2, C_4—.025 μfd., 200 v. cond.
C_3—4 μfd., 10 v. elec. cond.
C_5—.002 μfd., 200 v. cond.
S_1—S.p.d.t. sw.
S_2—2-pole, 2-pos. sw.
M_1—0-1 d.c. milliammeter
T_1—Output trans., 10,000 ohms plate to voice coil
J_1—Closed circuit jack
1—1T4 tube
1—3S4 or 3Q4 tube
1—4" PM Speaker

The ELECTROPLEX— a new automatic key

By JULIAN T. DIXON, W4AJY



Two views of the completed automatic key. It is capable of handling a speed range of from 9 to 35 words per minute.

Design and operation of dual automatic key—one which forms both dots and dashes automatically.

ONE item of equipment which is long overdue in many radiotelegraph stations is a dual-automatic key— one which forms both dots and dashes automatically. The *Electroplex* is the result of an effort to provide a practical dual-automatic key which might be acceptable for general use by the radio operating fraternity. It is of simple design, yet has a number of features which in combination give the *Electroplex* definite advantages over previous dual-automatic keys.

This unit is designed to eliminate to a considerable degree the need for precise timing on the part of the operator. It incorporates circuits which selectively form sequences of dots or dashes with each dot, dash, and intervening space being timed much more accurately than is possible with ordinary hand sending. It is controlled by means of a single-pole double-throw switch, thereby minimizing the number of mechanical adjustments required. This simplified control switch assures accurate and easy manipulation at high speed. It is not, however, primarily a high speed key. The model described here has a speed range of from nine to thirty-five words per minute, adjustable by means of a single potentiometer to the desired value. Thus, it is suitable for use by both the beginner and the more advanced operator. In fact, the beginner's problems are simplified appreciably because the key takes over the job of timing each dot and dash correctly. It will be shown how the key completes a correctly timed dot or dash even though the control switch may be opened in the middle of one of these marks.

The model illustrated comprises four basic components which will be described in the following order: (1) timing circuit, (2) control circuit, (3) audio frequency monitoring oscillator, (4) power supply.

The Timing Circuit

The timing circuit utilizes a dual triode tube, V_1, the respective sections of the tube being designated V_{1A} and V_{1B}. This tube and its associated circuit elements are connected in a specialized form of multivibrator circuit designed particularly for this key.

One important characteristic of multivibrator circuits in general is that plate current flows in one and only one of the two tubes at any given time. In a free-running multivibrator, the tubes conduct plate current alternately. They approximate a switch which changes the flow of plate current from one plate load resistor to the other at a frequency which is determined by the circuit design. It will be noted that the coil of relay RL_1 is part of the plate load of V_{1B}. Thus, when V_{1B} conducts, the relay contacts close and when V_{1A} conducts the contacts open.

It will now be seen that when V_{1A} conducts a space is formed and when V_{1B} conducts a mark (either a dot or a dash) is formed. So, in order to transmit a sequence of dashes V_{1A} should be non-conducting three times as long as is V_{1B} during each cycle. This proportion is obtained by making the time constant of the grid circuit of V_{1A} three times as great as the time constant of the V_{1B} grid circuit. These time constants are approximately the product of the grid leak resistance and the capacitance of the corresponding grid coupling condenser. The coupling condensers, C_3 and C_4 have equal capacitances so that the non-conducting time of each tube is approximately proportional to the magnitude of its grid leak resistance. The grid leak resistance of V_{1A} is the sum of R_{10}, R_{12} and R_{13}, while the grid leak resistance of V_{1B} is R_2 and R_3 in series.

The potentiometers R_3 and R_{12} are provided for exact adjustment of the spaces and dashes, respectively, with relation to the dot length which is determined principally by R_{10}. These potentiometers are screwdriver adjustments which need not be changed after the correct settings have been determined by means of a simple alignment procedure to be described later.

The frequency of a multivibrator may be changed conveniently by vary-

ing the positive voltage to which the grid leaks of the tubes are returned. In this circuit, the frequency is almost directly proportional to the positive bias voltage obtained from potentiometer R_{12} which is part of a voltage divider connected across the high voltage power supply. Consequently, R_{12} functions as the transmission speed control but does not change the relative lengths of the dots, dashes and spaces. This is a front panel control and is mounted just above the control switch lever. It may be provided with a scale calibrated in words-per-minute as will be described in connection with the alignment procedure.

It was found that R_5 and C_5 shunted across the relay coil provided the damping necessary to reduce the transient voltage induced in the coil when the current in V_{1B} changes suddenly at the beginning and end of each mark. Resistors R_9 and R_4 serve to stabilize the operation of the circuit and to enable positive, immediate, response when the control switch is closed.

The Control Circuit

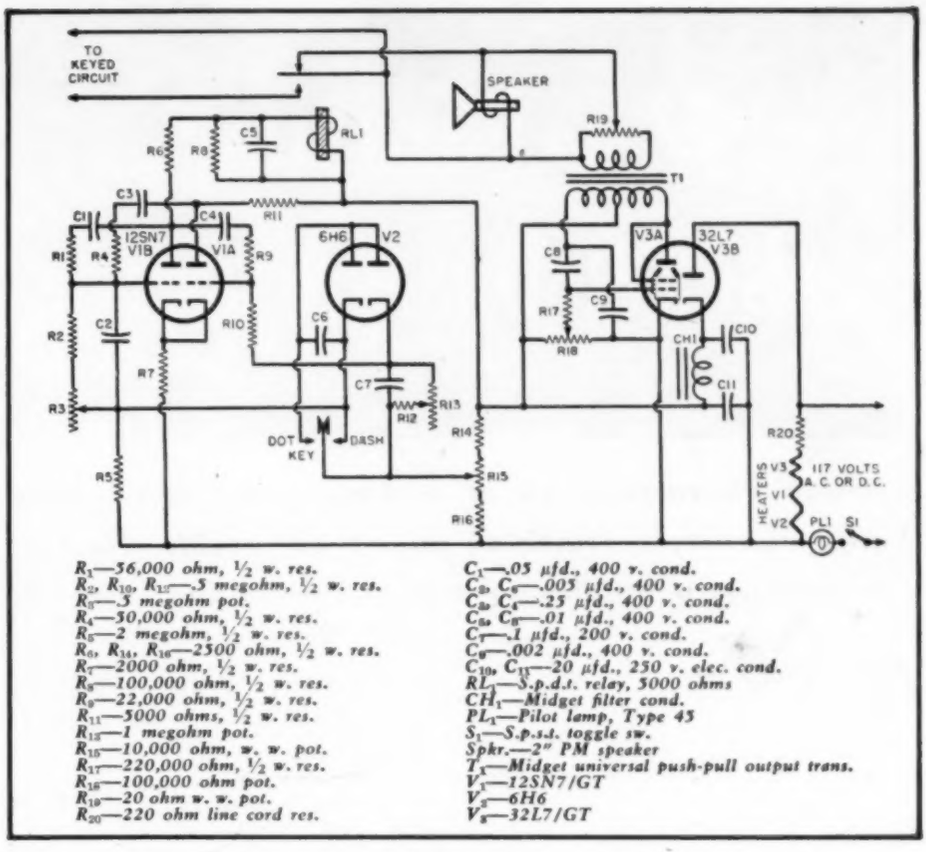
Thus far, the timing circuit has been treated as a free-running multivibrator sending a continuous sequence of marks. The control circuit functions to start and stop the timing circuit and to determine whether dots or dashes are to be transmitted. It operates in response to manipulation of the control switch, or key, which is shown in the neutral position.

When the control switch is in the neutral position as shown, V_{1B} is biased beyond cut-off by the voltage developed across the common cathode resistor R_7. This negative bias is developed by the plate current of V_{1A}, which is conducting steadily because its grid leak is returned to the positive bias at R_{13}. It will be noted that the grid leak of V_{1B} is returned to the negative end of R_7 through a very high resistance, R_5.

Now, suppose that it is desired to transmit dashes. The control switch is moved to the dash contact, thereby connecting the positive bias from R_{13} to the grid leak of V_{1B}. The initial voltage surge is coupled through C_2 directly to the grid V_{1B}, driving the grid voltage up to zero immediately and causing plate current to begin flowing through this tube. Simultaneously, V_{1A} is cut off because, as previously explained, only one of the tubes can conduct at any given time. Thereafter, the circuit operates as a free-running multivibrator, forming a sequence of dashes which continues as long as the control switch is held in the dash position.

The duo-diode, V_2, operates as an electronic switch. When the control switch is moved to the dot contact, the multivibrator begins operation as previously explained because one section of V_2 conducts current from R_{13} to the grid leak of V_{1B}. The other section of V_2 simultaneously shunts R_{12} and R_{13}, thereby reducing the time constant of the V_{1A} grid circuit to one-third of its former value and making it equal to the V_{1B} grid circuit time constant. These two circuit changes are accomplished with only a single circuit through the control switch. The current keyed by the switch contacts is very small, about one-half milliampere or less according to the setting of the speed control.

The internal resistance of the diodes is about 1000 ohms, very low relative to the resistances which they shunt, and is considered to have negligible effect on the circuit operation.



R_1—36,000 ohm, ½ w. res.
R_2, R_{10}, R_{15}—.5 megohm, ½ w. res.
R_3—.5 megohm pot.
R_4—50,000 ohm, ½ w. res.
R_5—2 megohm, ½ w. res.
R_6, R_{14}, R_{16}—2500 ohm, ½ w. res.
R_7—2000 ohm, ½ w. res.
R_8—100,000 ohm, ½ w. res.
R_9—22,000 ohm, ½ w. res.
R_{11}—5000 ohms, ½ w. res.
R_{12}—1 megohm pot.
R_{13}—10,000 ohm, w. w. pot.
R_{17}—220,000 ohm, ½ w. res.
R_{18}—100,000 ohm pot.
R_{19}—20 ohm w. w. pot.
R_{20}—220 ohm line cord res.

C_1—.05 μfd., 400 v. cond.
C_2, C_6—.005 μfd., 400 v. cond.
C_3, C_4—.25 μfd., 400 v. cond.
C_5, C_8—.01 μfd., 400 v. cond.
C_7—.1 μfd., 200 v. cond.
C_9—.002 μfd., 400 v. cond.
C_{10}, C_{11}—20 μfd., 250 v. elec. cond.
RL_1—S.p.d.t. relay, 5000 ohms
CH_1—Midget filter cond.
PL_1—Pilot lamp, Type 43
S_1—S.p.s.t. toggle sw.
Spkr.—2" PM speaker
T_1—Midget universal push-pull output trans.
V_1—12SN7/GT
V_2—6H6
V_3—32L7/GT

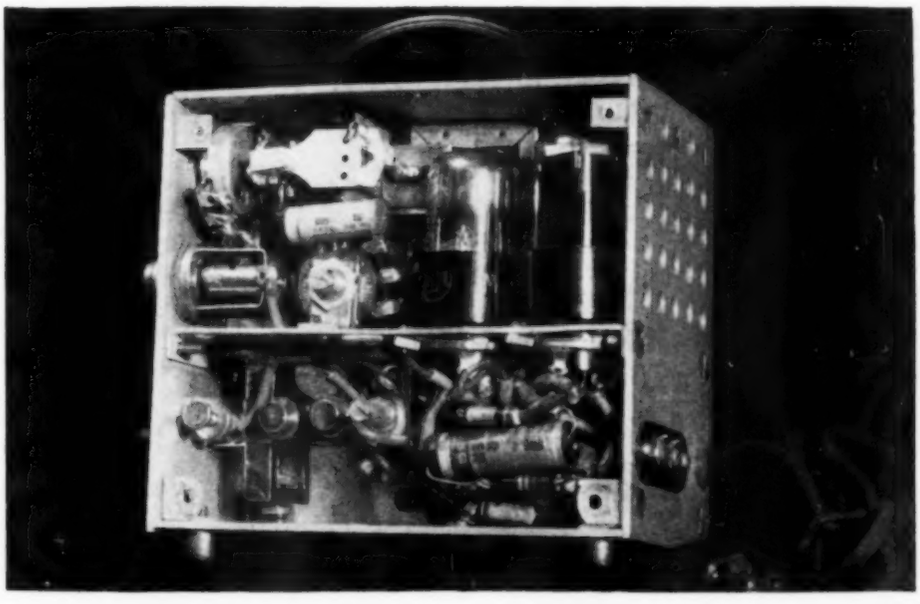
Schematic diagram of automatic key. Fundamental frequency of oscillator is variable from approximately 400 to 2000 cycles-per-second.

Condenser C_7 prevents a dot from being changed to a dash in the event the control switch is opened in the middle of a dot. In that event, C_7 shunts sufficient current around R_{12} and R_{13} to be considered a momentary short circuit for sufficient time to permit the formation of a correctly timed dot.

It would be undesirable to clip a dash too short by opening the control switch before the final dash of a sequence is completed. This possibility is avoided here by providing negative

(*Continued on page* 148)

Rear view of the completed unit. Ventilation is provided by perforating the chassis, and back and bottom of cabinet.



New Parasitic Beam Design

By
R. G. ROWE, W2FMF
Consulting Engineer

Design characteristics of a 4-element, close-spaced antenna array featuring novel adjustable element length. Data applies to arrays for 28 mc. and up.

THE following article describes a four-element, ten-meter, close-spaced array based upon the Plumber's Delight, but having a distinctive feature in the way of adjusting element lengths not heretofore disclosed to the best of the writer's knowledge.

While the design principles are not limited to any practical number of elements or element spacings, from a mechanical standpoint they can be best applied to arrays for 28 megacycles and higher, due to the relatively short element lengths required at these frequencies.

QUARTER-WAVE SECTION	LENGTH IN FEET
D1-D2	$\frac{225}{f(mc.)}$
A	$\frac{234}{f(mc.)}$
R	$\frac{246}{f(mc.)}$

Table 1. Formulas for calculating the various element lengths (shown in Fig. 1) for specific frequencies.

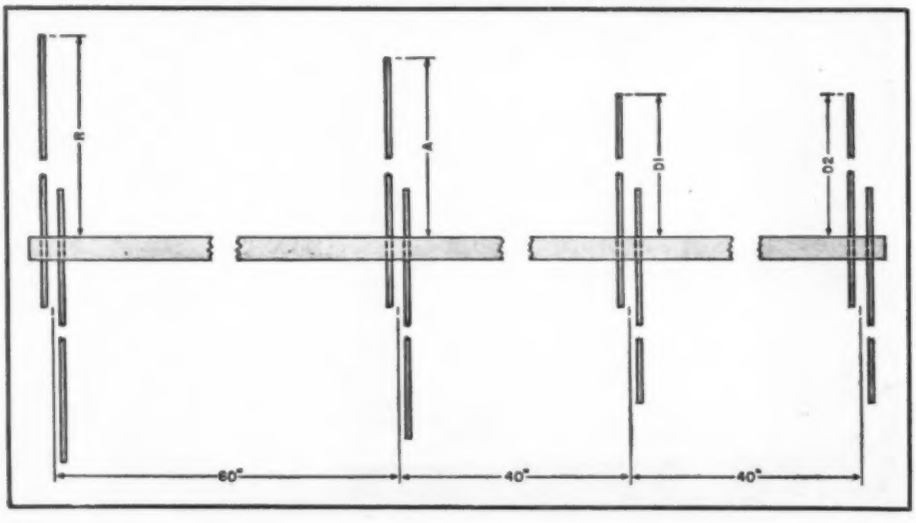
The novel mechanical design arises from the method of staggering quarter-wave sections of each element along the central carrying tube, as shown in Figs. 1 and 3, thereby permitting simple adjustment of element length from the center of each half-wave section and eliminating the need for telescopic sections. The protrusion of the short length of the butt end of each quarter-wave section does not deleteriously affect the gain or pattern of the array. The beam is made entirely from aluminum, with the exception of one small piece of insulation in the "T" matching section, later to be described. The metal frame, elements, matching section, and feed line are all electrically connected, permitting a single, permanent ground connection to afford protection from lightning and static discharge.

The central carrying structure, or "frame," for the particular ten-meter beam illustrated is made from a 12 foot length of 2 inch o.d. aluminum tube with a wall thickness of one sixteenth inch. An inspection of Fig. 4 shows how the tube is drilled at the spacings indicated in Fig. 1. A "stagger" distance of 1.5 inches was used in this particular embodiment, with 0.5 inch diameter thin-wall elements. The stagger distance should be minimized as much as possible, becoming progressively critical at higher and higher frequencies. The frame holes should provide a snug fit for the butt ends of the elements, yet permit them to slide when the clamping bolts are loosened. Small holes through the bottom of the frame, indicated in Fig. 4, are drilled to permit the insertion of the so-called "J" bolts. These bolts may be formed from eye bolts, "U" bolts or bent up from straight bolts. Tightening the wing nuts securely locks the elements in place, whereas loosening them slightly permits simple adjustment of the length of each quarter-wave section.

The quarter-wave sections may be scribed or otherwise ruled off at their butt ends to facilitate reading the over-all length. In the illustrated beam, short pieces of friction tape were wound around each element near the butt end at a predetermined, measured length from the tip. Thus, by measuring the short distance from the frame to the tape, it is possible to balance the length of each section easily as well as to mentally calculate the over-all length rapidly, without using a long rule or tape to measure the tip-to-tip length. All adjustments and measurements may be made at the center of each half-wave section, greatly facilitating installation and tuning.

Fig. 5 indicates a possible method for mounting the frame at its mechanical balance point on a short length of grooved 2 x 4 with "U" bolts. A pipe flange is screwed to the underside of the 2 x 4 to take a short 12 inch length of pipe, the i.d. of which just will slip over the o.d. of the supporting pipe, providing a bearing for rotation. In the illustrated arrangement, a ½ inch galvanized water pipe is used as the supporting pipe, for inasmuch as the array is close to the chimney bracket and the supporting pipe is short, greater rigidity is not required. Many other ways to sup-

Fig. 1. Diagram shows how the 12 foot, 2 inch o.d. aluminum tube is drilled to support the various antenna elements. Constructed unit is shown in Fig. 2.



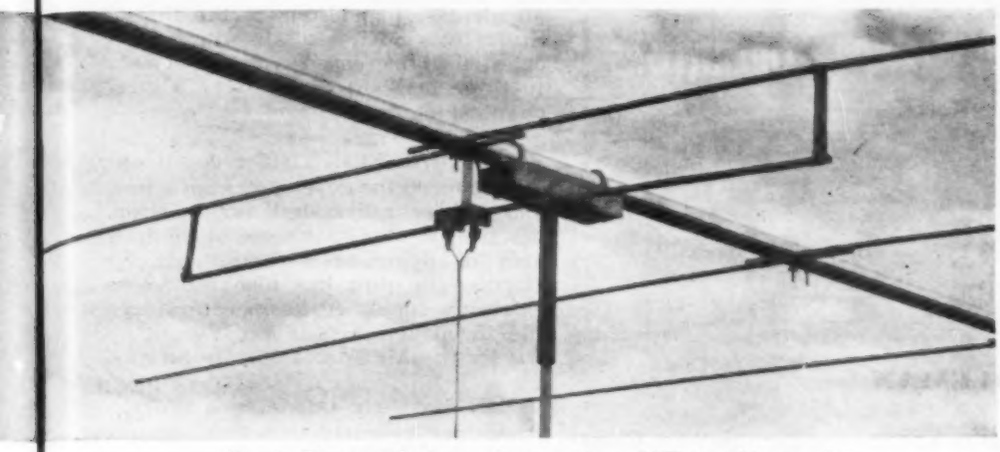


Fig. 2. Photograph shows close-up view of "T" matching section.

port and to rotate such arrays have been fully described in the literature or will suggest themselves to the ham. In the illustrated mounting the tube frame was grounded to the pipe flange by a short length of copper braid, inasmuch as the supporting pipe and chimney bracket are permanently grounded to a vent pipe in the roof of the house for lightning protection. A potential method for rotating the array is to bring the base end of the supporting pipe through the roof. A section of small o.d. tube may be inserted inside the supporting pipe, mechanically secured to the 2 x 4 and provided at its lower projecting extremity with a wheel or lever for rotation.

For this type of beam the "T" match, delta match or folded dipole feed is most easily adaptable. However, by drilling oversize the frame holes which carry the driven element, insulated bushings may be inserted at this voltage node to insulate each quarter wave of the antenna section from the frame so that other types of feed may be used.

The "T" match shown in Figs. 2 and 6 was selected for this particular application and the "T" section is made up from two 33 inch lengths of ½ inch o.d. thin-wall aluminum tube, the same diameter as the elements. A small block of ½ inch thick bakelite serves to mechanically connect and electrically insulate the inner fed ends of the "T." The block is so dimensioned that the stagger distance of 1.5 inches is maintained in the "T" section and is supported from the tube frame for rigidity. The shorting straps, which are adjustable along the length of the elements and "T" section, are formed from one sixteenth inch thick aluminum sheet, 1 inch wide. They are provided at each end with a hole for the passage of a bolt and wing nut to tightly clamp the tubing. By loosening the two wing nuts on each shorting strap, each strap may be slid in or out along the length of the element to minimize standing waves on the feed line, after the beam has been tuned by any one of several tuning procedures outlined in the various antenna handbooks. 300 ohm twin-lead type feeders are used with the illustrated beam and connected as shown in Fig. 6.

Before final installation of the illustrated "T" section made from aluminum tube and aluminum shorting straps, a temporary "T" section using No. 8 copper wire was used with excellent results. If a wire "T" section is used the vertical spacing may remain 4 inches and the distance "T" determined by noting the standing wave ratio.

A convenient, qualitative check for standing waves on the twin-lead type line may be made by running a neon bulb along the line for a distance of some ten feet, on ten meters. If the bulb brilliancy remains reasonably uniform, the line is reasonably flat. If the brilliancy varies, the distance "T" should be readjusted. The total distance "T" for the separation of the shorting straps will be somewhere between 40 and 60 inches. While the illustrated beam has been adjusted for maximum forward gain and minimum standing wave ratio at 29 megacycles, it has been used without readjustment from 28.1 to 29.4 megacycles. At these frequency extremeties the standing wave ratio becomes appreciable and coupling to the final tank must be altered. However, with 600 watts input to a BC610E transmitter the 300 ohm twin-lead does not break down.

The staggered element design is not limited to the particular element or frame sizes shown. In the illustrated array the ½ inch thin-wall aluminum elements seemed rather light and flexible. Some lengths of thick-wall aluminum pipe were found in a war surplus stock, the o.d. of which would drive fit the i.d. of the ½ inch elements. Therefore, 2½ foot lengths of the pipe were driven into the butt end of each of the quarter-wave elements.

In working with arrays using a metal center structure of appreciable diameter, the writer has noticed that the popular formulas for calculating the tip-to-tip element lengths seemed to give elements which were too short according to maximum forward gain measurements. It has been determined roughly that by adding the width of the frame to the calculated lengths such an effect is obviated.

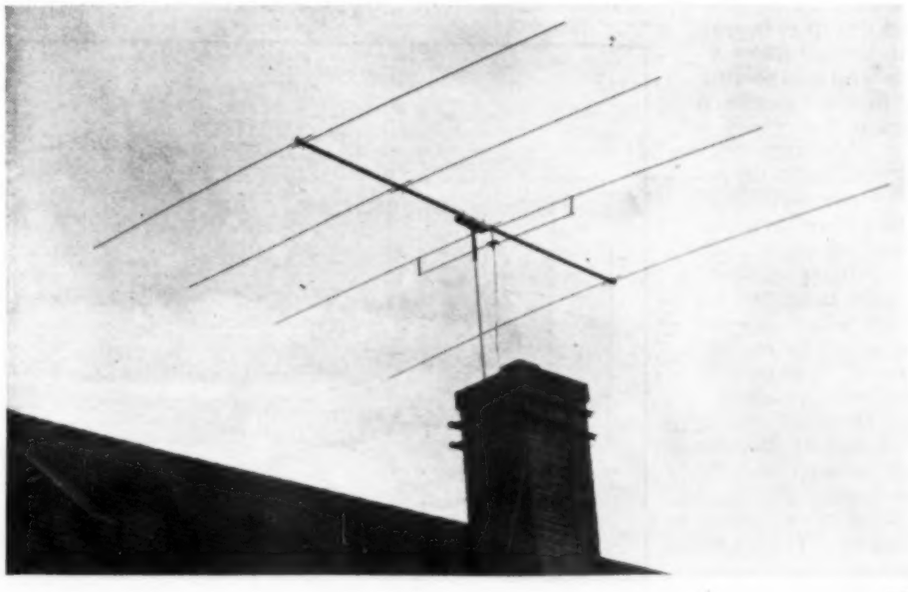
Accordingly, it is to be noted in Fig. 1 that the dimensions for *D* 1, *D* 2, *A* and *R*, calculated from Table 1, are measured from the outer wall of the 2 inch tube frame to the element tip. The formulas give the dimensions for each quarter-wave section of each element, which is the measured distance from opposing sides of the tube frame to the tip of each corresponding quarter-wave element, or the distance which each quarter-wave element projects from the side of the frame. The total over-all cut length of the various quarter-wave sections, to permit adjustment from 28 to 30 megacycles, is:

$$D\ 1\ \&\ D\ 2 = 8'\ 2''$$
$$A = 8'\ 6\tfrac{1}{4}''$$
$$R = 9'\ 0''$$

It will be obvious from this that this beam requires for the elements, 4 lengths of tubing 8′ 8″ long, 2 lengths 9′ 0¼″ long and 2 lengths 9′ 6″ long; for the frame, 1 length of larger o.d. tubing 12′ long; and for the "T" sec-

(*Continued on page* 88)

Fig. 3. 10 meter antenna constructed by author. Main support is made of ½" galvanized pipe.



By CARL COLEMAN

ALTHOUGH the recent maritime strike is hardly over and there is talk of another, the *American Merchant Marine Institute* President F. J. Taylor, recently predicted uninterrupted maritime activity for some time to come. . . . It was pointed out that with recent wage increases in all groups of personnel there would be no reason for another stoppage in the maritime shipping field.

During the recent strike there was a strong tendency to transfer cargo originally scheduled for American vessels to foreign flag ships in order to eliminate delays due to the labor troubles, it should be recognized by the unions that such action by concerns shipping goods to foreign ports will take place more and more and American shipping must operate continuously if it is to compete with such foreign vessels operating steadily out of American ports . . . that these foreign firms are really out for the trade can be seen in some of the recent arrivals of new foreign ships, a recent arrival, the Houffalize (Belgian), an 18½ knot vessel of 11,000 tons with the usual accommodations for 12 passengers. . . . The vessel is a triple screw job, diesel powered . . . this is the second of three such ships to be operated by the Belgian Line. The first of the three was the Stavelot which made her maiden voyage last spring.

Various other foreign firms are either building new ships or, in some cases, purchasing American built vessels and converting them for their own runs and services.

A. C. WELLS reported back in New York after a vacation. . . . M. C. Wilson arrived in port recently and after being around for some time contracted pneumonia and was hospitalized for some weeks —MC will be up and around shortly we hope.

Alan Van Siclen recently relieved aboard his Mariners Splice and started for the West Coast —Alan has ambition for a run down the west coast from Frisco to the Canal. . . . Dave Grossert reported back in the big town and shipping out recently. Harold Koch back at Charleston after a vacation home in the Mid-west. . . . Ed Stetson down to Philadelphia for several days, says he likes Jersey City better. . . . Joe Malony unreported the past month. . . . D. K. Crosby around town for a while to say "hello" to the old gang. C. E. Williams off a while ago to do a little fishing and hunting—and ran afoul one of those black kitties with the white stripe! CE came off a close second.

LATEST reports from the *Maritime Commission* reveal that about fifty-one per-cent of the world's merchant shipping tonnage is under the American flag compared with only fourteen per-cent in pre-war days of 1939. There is over 50 million tons under the U. S. flag and nearly five million more under various foreign flags is owned by United States shipping outfits. England, which is constructing most of the new tonnage now being built, shows a decline from the 1939 figure of 12,798 to 12,445 in 1946. However, world tonnage increased from 80,601,000 to 99,220,000 tons.

Wartime construction of about 2000 Libertys accounted for this trend. Only other major maritime nation to show an increase in addition to the United States was Soviet Russia whose merchant fleet increased from 2 per-cent to three per-cent of the world's merchant shipping tonnage.

"You heard wrong. I didn't say I had radio tubes for sale!" RADIO NEWS

GENERAL ELECTRIC recently announced the development of a new and lighter radar unit for aviation, designed to eliminate some of the hazards of flying in darkness, fog, or storms—the unit has also been considerably simplified in operation over the 150 pound APS-10 radar built by *GE* for the Air Forces during the war.

THE *Maritime Commission* did announce recently that 1695 vessels were now in Merchant Marine Reserve Fleet anchorages throughout the country as of Oct. 15th. . . . During the period Sept. 15th to Oct. 15th 46 vessels were withdrawn for sale, service or scrapping, it was announced.

Among the new shipping interests is the announcement of the completion of reconversion of the "America"—largest of the U. S. built ships which has been completely overhauled since her "West Point" days and is said to be one of the finest vessels afloat for the North Atlantic passenger trade—the vessel left Newport News recently (where she was built) for New York to shortly engage in her prewar trans-Atlantic trade.

SALES reported in progress are 50 Libertys to Italy, Holland also reported after quite a number of these craft—Holland-American Line looking for four Victories . . . France reported after about 75 vessels. . . . Matson has shifted four ships to Panama registry recently.

RMCA's new radar unit reported ready for installations aboard the merchant fleet. *Raytheon* recently fitted out the Drottningholm with new radar gear—a new design commercial unit for marine use.

STEAMSHIP companies still in a struggle with CAB trying to get charters for overseas flying—CAB still interprets the law in a manner which prohibits steamship lines from operating airlines, American Export the only shipping line ever to get into the air business was forced to get rid of its airline by CAB.

Waterman, Matson, United Fruit, Grace and American South African are among those seeking permission for airlines in conjunction with their sea routes.

CONGRATS to Lt. Col. F. J. Shannon, who received the air medal for his part in the flight of the "Dreamboat" from Hawaii to Cairo. . . . Frank in civilian life is connected with WCAU. . . . Fred Pratt still out of town and has not been seen for some time. . . . S. G. Hopkins and E. H. Robinson, recently cited by WSA, just before the end of that unit, for their part in wartime aboard their vessels. 73

Crystal Diode Applications

By
J. C. HOADLEY

Fig. 1. Use of crystal diode permits simple and compact construction of a.c. probes.

Author covers several of the more common applications of the new type 1N34 crystal diode.

THE *Sylvania Electric Company* has recently placed on the market a very useful item, a crystal diode called the 1N34. Only slightly larger than a one-watt resistor and made with similar axial pigtail leads, it can be soldered directly into a circuit, eliminating the necessity for a tube socket with its attendant space consumption. If we keep in mind the certain limitations of these superb little rectifiers, we can find many applications for them.

The first thing to consider is the diode's inverse peak voltage rating of 50 volts. This, of course, is rather low compared to a vacuum tube, but we can hook as many of these crystals in series as we like, to obtain a higher voltage rating. Even several crystals still do not take up as much room as a miniature vacuum tube diode.

Maximum current of the crystal diode is limited to 22 ma. average (60 ma. peak) which, incidentally, is more than several times higher than a 6H6 or 6AL5. However, it has several important advantages; among these, no heater and, therefore, no heater cathode capacity or pickup. It is difficult to connect a vacuum tube diode so that the cathode is at a high positive potential because of heater cathode leakage, so a separate heater winding must be provided and, even then, there is the heater cathode capacity.

Our diode's input capacity is in the order of 3 micromicrofarads, which is very low. Its forward resistance is lower than a vacuum tube diode and its back resistance is also lower. The two resistances are in the order of 100 ohms and ½ megohm, although the back resistance varies with the individual units and applied voltage. It is desirable to choose a load resistance for the crystal diode which will cause no appreciable effect. There are applications where this back resistance is advantageous, as we get a diode with a load resistance thrown in free.

A very useful characteristic of this diode is its frequency response. It is flat from zero to 100 megacycles. This makes it ideal for use as a meter rectifier, among other things. The usual a.c. voltmeter using a copper oxide rectifier has relatively poor frequency response, falling off above several thousand cycles-per-second. It is inexpensive to convert your a.c. voltmeter to one whose frequency response is flat as far up the frequency range as the loading and other conditions will allow.

Keep in mind that not over thirty odd r.m.s. volts should be applied to one crystal. This can be overcome by series connection of two or more crystals. As the high frequency voltages which are usually measured are seldom over 100 volts, and are usually much less, this is not as serious a restriction as would first be supposed.

Let us consider some applications of this versatile little diode. The first one to come to mind is its use as a detector. From the beginning of radio, crystals have been used for detectors. They have fallen into disuse in recent years because of the critical adjustment of catwhiskers, etc. This problem has been solved, however, and the 1N34 is permanently adjusted.

In Fig. 2 is shown a detector circuit for use in a superheterodyne or tuned radio frequency receiver; or, if preferred, the circuit in Fig. 4 may be used as it has a higher output voltage. The sizes of R_1 and C_1 in Fig. 2 depend on the audio response required. It functions as a filter to remove the radio frequency component without attenuating the higher audio frequencies. We will probably want automatic volume control.

Fig. 3 shows the connection for a detector and a.v.c. rectifier. Notice that the diodes are reversed, as a negative voltage is needed for a.v.c. which determines the polarity of the a.v.c. diode. We then connect the detector diode with the opposite polarity to even up the load on the last r.f. or i.f. stage. Of course these diodes can be used to replace the diode tubes in an FM discriminator.

For the serviceman, one of these small diodes, a condenser and resistor made into a miniature probe and connected directly to a pair of earphones, makes a convenient signal tracer which may be slipped into the pocket and will never require new batteries or any attention.

The photograph in Fig. 1 shows a neat way to construct a crystal probe. First, saw the metal shell from a medium size metal tube such as the 6SJ7 or 6SK7 and cut an insulating disc that fits snugly into the open end. Drill and tap several holes for 2-56

(*Continued on page* 153)

Fig. 2. Detector circuit designed around the 1N34 crystal diode which may be incorporated in either superheterodyne or TRF receivers.

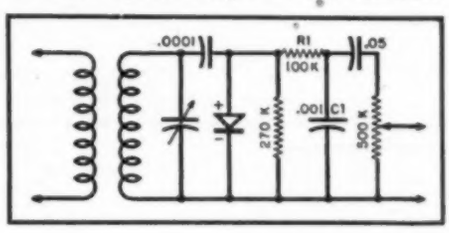
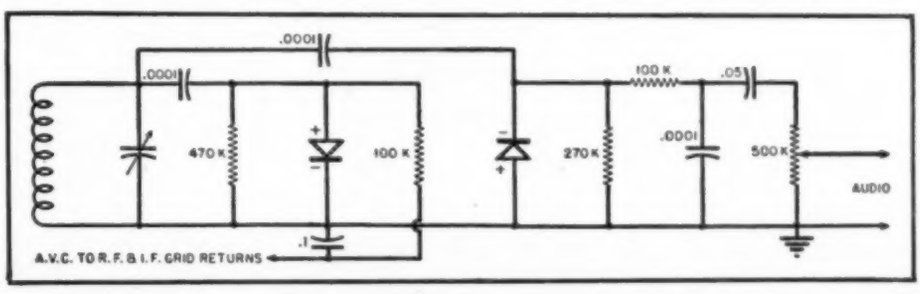
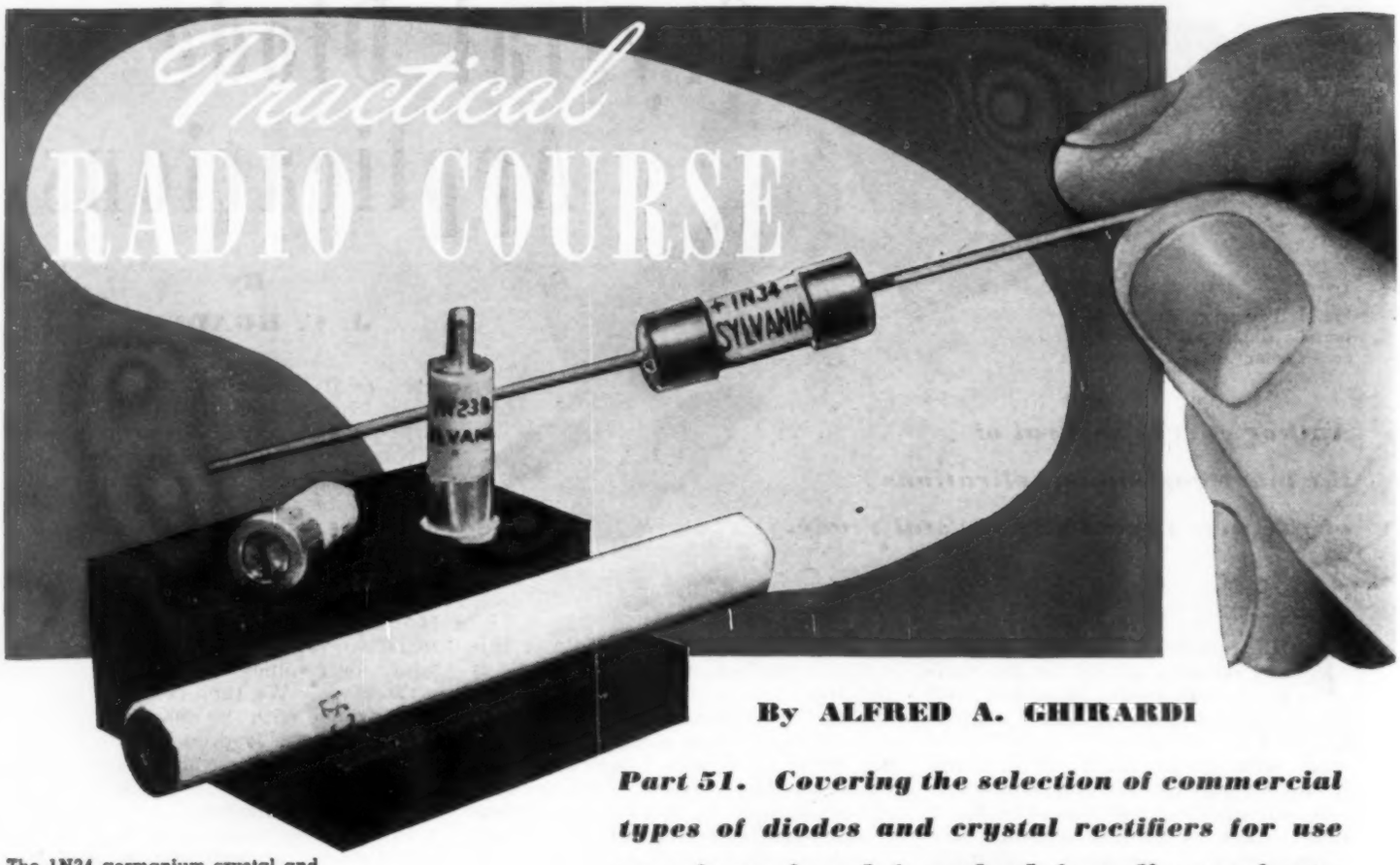


Fig. 3. Two crystal diodes replace a vacuum tube in this detector and a.v.c. circuit.



Practical RADIO COURSE



The 1N34 germanium crystal and the 1N23B silicon type rectifiers.

By ALFRED A. GHIRARDI

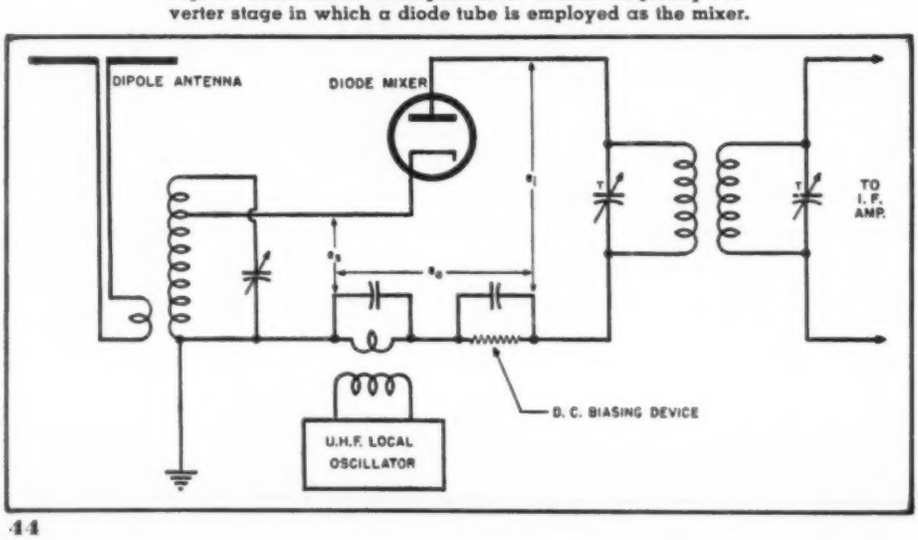
Part 51. Covering the selection of commercial types of diodes and crystal rectifiers for use as mixers in u.h.f. and s.h.f. radio receivers.

THE inherent tendency of mixer and converter tubes to give poorer performance at the high frequencies is important now that television, FM and u.h.f. services are becoming widely used. As the operating frequency of receivers is increased, it becomes more and more difficult to obtain satisfactory, efficient frequency conversion.

In ordinary converter tubes, poor oscillator action, together with the undesirable space-charge coupling and transit-time effects limit the use to frequencies of about 30 mc. (10 meters) or so. The more recent improved forms of converter tubes provide satisfactory operation up to higher frequencies; for example, the 6SB7Y improved pentagrid converter tube provides stable, satisfactory frequency conversion in the FM broadcast band (88 to 108 mc.). However, it is generally true that a separate oscillator can be built with better high-frequency characteristics than can a built-in oscillator. Also, because the method used to introduce the oscillator voltage into the mixing part of the system can generally be chosen to better advantage with a separate oscillator than with a built-in oscillator, a frequency converter employing a mixer and separate oscillator tube can generally be designed to provide better high-frequency operation than is obtained with a converter tube. In general, also, mixer tubes are usable at higher frequencies than converter tubes, as the mixer may be used with a specially designed oscillator tube suitable for high-frequency operation (for example the acorn type 6F4 triode oscillator can be used to generate frequencies up to approximately 1200 mc.). Triode-heptodes and triode-hexode converter tubes may be used to fairly high frequencies also.

In the u.h.f. region, the oscillator sections of ordinary converter tubes cease to function altogether. Consequently ordinary converter tubes must be replaced by special types of mixer tubes (diodes), and vacuum-tube oscillators designed specifically for these frequencies. These too, fail to function as the frequency is increased beyond certain values. Above these, other types of frequency converters must be employed, as we shall presently see.

Fig. 1. Basic circuit arrangement for a u.h.f. frequency converter stage in which a diode tube is employed as the mixer.



Use of Diodes as Mixers at U.H.F.

A simple diode tube (2-element tube) can serve as the non-linear element in a single-electrode input type mixer. During the past few years diode tubes have become appreciated for the advantages they possess for operation in the region of ultra-high signal frequencies where ordinary

multi-electrode types of mixer and converter tubes cease to operate satisfactorily. Accordingly, they have become popular for use in u.h.f. superheterodyne receivers.

The basic diode mixer stage consists of an input circuit tuned to the signal frequency, an output circuit tuned to the i.f., a source of local-oscillator voltage, and a source of d.c. bias (from a bias battery or a bypassed voltage-dropping resistor). The basic schematic circuit diagram of such an arrangement is illustrated in Fig. 1. In u.h.f. receivers, the signal and oscillator tuning elements may take the form of resonant lines, or cavity resonators. The oscillator voltage may be injected by means of a small coupling loop inserted in the resonant cavity. The oscillator voltage needs to be selected within a range that results in good over-all sensitivity and low noise.

Operation of Diode as a Mixer

Although the diode is the simplest type of vacuum tube, its behavior as a single-electrode input type mixer has not been clearly understood until fairly recently. One reason for this is that the frequency-conversion process is more complex than in conventional type of mixers in that it is bilateral, i.e., the diode mixer converts in *both* directions. It converts the applied signal-frequency and oscillator-frequency input voltages to an i.f. output; since this i.f. output and the oscillator-frequency voltage appear in the same circuit (see Fig. 1), it will reconvert them back to a signal-frequency current in the input. As the degree to which this occurs depends upon the impedance of the respective circuit elements to the two frequencies, the effect can be minimized by proper design.

Because no amplification is produced by a diode tube (since it does not contain a grid), no conversion gain is obtained in a diode mixer. Actually, there is a conversion *loss*, due to losses in the various circuit elements associated with the tube. If the conversion loss is to be held small, the diode must be operated so as to obtain the highest ratio of conversion conductance to average conductance. The upper limit of this ratio is unity, and this is attained only when the mixer-stage impedance is infinite. Thus, circuit losses prevent the attainment of the condition of zero conversion loss in practice, so the diode mixer normally operates with some conversion *loss* (although it may be kept fairly low by suitable design). This is one of the disadvantages of this type of mixer. However, conventional types of mixer tubes cannot be operated in the u.h.f. region at all, so the diode mixer with its conversion loss is better than no mixer at all.

The diode should be operated with fairly high bias voltage, properly bypassed, and correspondingly high oscillator voltage injection. Under these conditions of operation the output is essentially proportional to the input signal voltage, and small variations in oscillator voltage do not appreciably affect the conversion gain, percentage-wise.

Another disadvantage of the diode mixer is that the current it draws places a load on the tuned signal-input circuit at frequencies lower than 30 mc. (approximately), which tends to cause broad tuning. On the other hand, at extremely high frequencies where the input impedance of the conventional types of mixers is very low due to electron transit time effects, the diode places less load on the tuned circuit. This is one of its important advantages in u.h.f. receivers.

The damping effects of the diode on the signal input circuit can be decreased by tapping the diode down on the signal-tuning coil (as shown in Fig. 1) instead of connecting across the entire inductance. The signal voltage reduction caused by the resulting step-down transformer effect is offset by the increased tuned circuit Q resulting from the decreased loading.

The diode mixer, in common with all single-electrode input type mixers, has a very high oscillator-harmonic response. This is fortunate, for it permits operation of the local oscillator at a comparatively low fundamental frequency (where its stability is good, and its output high), a harmonic frequency of the oscillator being used for the mixing. As a result, the frequency drift of the receiver (which is dependent mainly on the frequency stability of the oscillator) is greatly reduced.

The elements of diode tubes used as u.h.f. mixers must be small, and the cathode and plate should be mounted close together to minimize electron transit-time effects. Special high-frequency diodes are now available for use in receivers designed for operation at frequencies up to the vicinity of 2000 mc. (15 cm.).

Device	Number of Electrodes to which Input is Applied	Type of Coupling Between Oscillator and Mixer	Type of Operation	Type of Tube Used	Comments	Installments of this Series of Articles in which Examples of Electrode and Circuit Arrangements Employed May be Seen
Mixer	Single	Network	Sliding Q-point	Triode, Tetrode, Pentode (12SJ7, etc.)	Separate Osc. and Mixer Tubes Used	Figs. 2, 3, Part 44
Control-grid Autodyne Converter	Single	Network	Sliding Q-point	Tetrode, or R.F. Pentode (6C6, 6D6, 77, 78 etc.)	Osc. and Mixer Electrodes in Same Electron Stream	Fig. 1, Part 46
Converter	Single	Network	Sliding Q-point	Triode-Pentode (6F7 etc.)	Osc. and Mixer Electrodes in Separate Electron Streams	Fig. 2, Part 46
Mixer	Single	Network	Sliding Q-point	Diode Tube or Crystal Rectifier	Separate Osc. Tube Used	Figs. 1, 3, Part 51
Suppressor-grid Autodyne Converter	Double	Electron	Shifting Q-point	R.F. Pentode (6C6, 6D6, etc.)	Osc. and Mixer Electrodes in Same Electron Stream	Fig. 1, Part 48
Mixer	Double	Electron	Shifting Q-point	Simple Pentagrid Converter (6A8, etc.)	Osc. and Mixer Electrodes in same Electron Stream	Figs. 2, 4, Part 48
Converter	Double	Electron	Shifting Q-point	Modified Pentagrid Converter (6SA7,6SB7Y, etc.)	Osc. and Mixer Electrodes in same Electron Stream	Figs. 1, 2, 3, Part 49
Mixer	Double	Electron	Shifting Q-point	Pentagrid Mixer (6L7, etc.)	Separate Osc. and Mixer Tubes	Figs. 3, 5, Part 49
Converter	Double	Electron	Shifting Q-point	Triode-Heptode Converter (6J8 etc.)	Osc. and Mixer Electrodes in Separate Electron Streams	Figs. 6, 7, Part 49
Converter	Double	Electron	Shifting Q-point	Triode-Hexode Converter (6K8, etc.)	Osc. and Mixer Electrodes in Separate Electron Streams	Figs. 9A, 10, Part 49

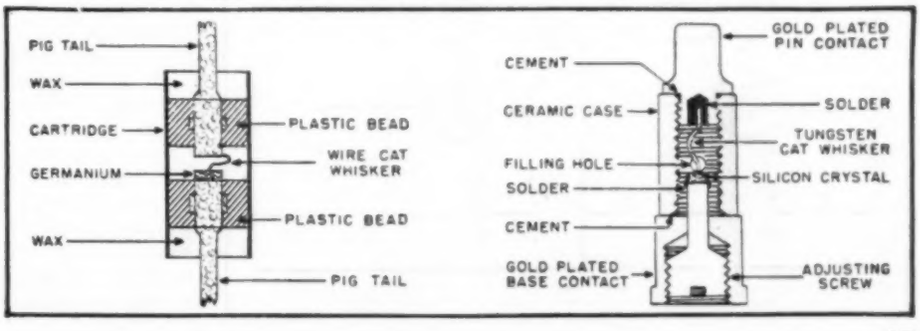
Table 1. Superheterodyne mixer and converter classification and summary.

Crystal Rectifiers for Use as Mixers at U.H.F. and S.H.F.

Improved forms of contact rectifiers (such as the new germanium and silicon types) are widely used as the

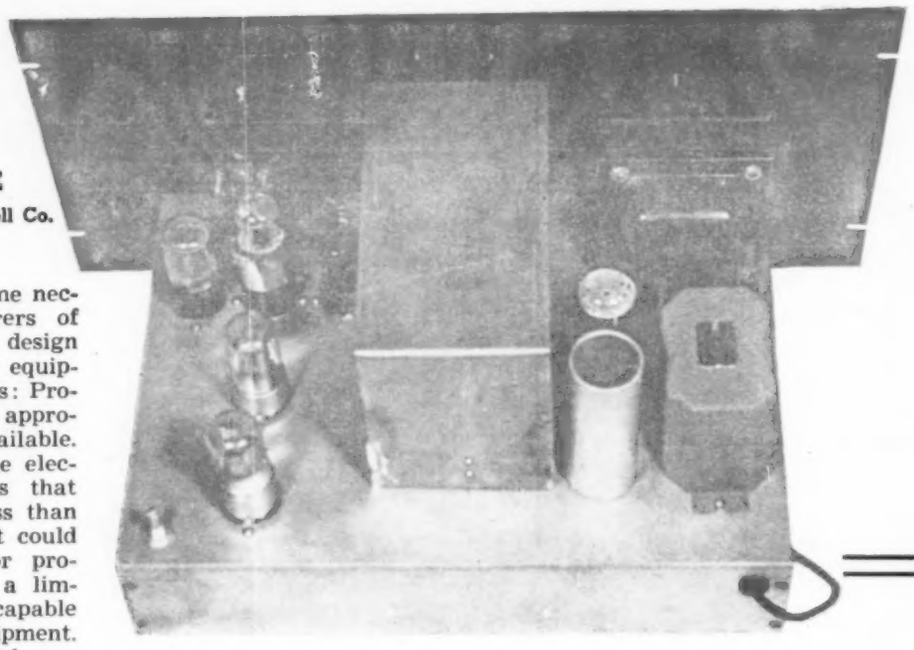
(*Continued on page* 151)

Fig. 2. (A) Sectional view of the Sylvania 1N34 germanium fixed crystal rectifier showing component parts. (B) The Sylvania 1N21B silicon type crystal rectifier for mixer use at higher frequencies.



RC Audio Oscillator

By
J. T. GOODE
Asst. Chief Eng. Packard-Bell Co.



Top of chassis view of commercially built audio oscillator.

Author presents construction details and a complete technical analysis of a Wien Bridge audio oscillator.

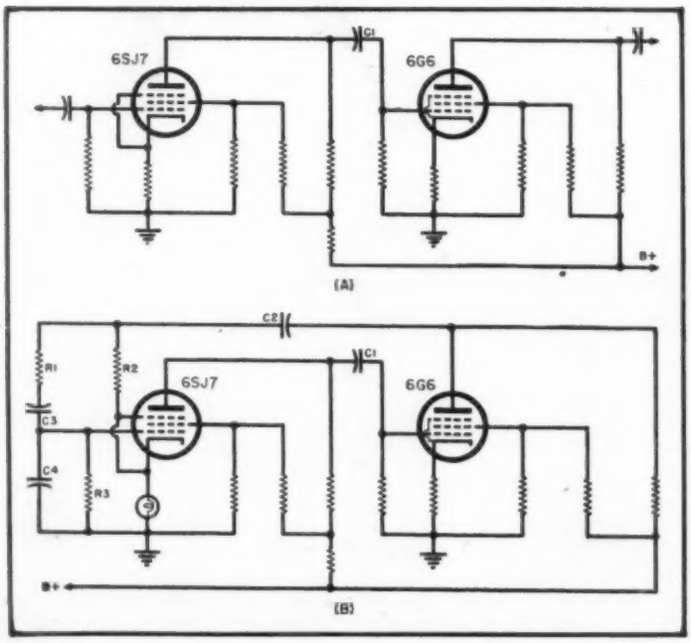
DURING the war it became necessary for manufacturers of electrical equipment to design and construct their own test equipment. Two things dictated this: Procurement; and the fact that no appropriate test equipment was available. Many military contracts in the electronic field had specifications that were so tight that nothing less than precision laboratory equipment could be considered satisfactory for production testing. There were a limited number of manufacturers capable of producing precision test equipment.

Precision test equipment which was available in many instances proved unsatisfactory for production use. The mechanical construction of this equipment was, in some instances, inadequate to withstand production usage. Another difficulty experienced was instability. Some laboratory standards require precise adjustment just before measurements are made, and such procedure is unsatisfactory for production use.

This article covers the operation and construction of an audio oscillator which was designed and used to supplement precision test equipment. It will be possible for a technician to construct this test equipment from the information given and produce a piece of equipment that is equal to precision laboratory equipment.

There are many uses for an audio oscillator if the oscillator is stable, accurate in calibration and free from distortion (less than 1%). The oscillator described in this article incorporates the above features. Some of the uses for such a piece of equipment are: Frequency calibration, fidelity measurements, and distortion measurements. For frequency measurements, the calibration must be accurate and remain that way. Fidelity measurements require low distortion and a constant output. Distortion measurements require a harmonic-free voltage source. A voltage source with harmonic content will give an indication of excess distortion, since the distortion meter will be indicating not only the distortion of the amplifier but also the distortion of the voltage source.

Fig. 1. (A) Simple two-stage audio amplifier circuit from which the basic Wien Bridge schematic (B) is derived.



Theoretical Operation

To successfully construct a piece of precision test equipment, it is helpful to understand the theoretical operation. Understanding the operation of the equipment puts the builder in a position to make slight final adjustments. The heart of this *RC* oscillator is, of course, the first two tubes which comprise the oscillator. A simple straightforward two-stage audio amplifier is shown in Fig. 1A. Note the absence of cathode and screen condensers. These condensers are omitted to reduce phase shift. Adding the condensers would increase the gain of the amplifier, but in the case of an *RC* oscillator, this is not necessary. Referring to Fig. 1B, we simply add *RC* networks composed of C_2R_1 and C_1R_2 to the grid circuit of the 6SJ7. The cathode resistor becomes a 3 watt Mazda lamp connected to the feedback circuit by R_2 with the addition of C_2 coupling condenser. The condenser C_2 causes the circuit to oscillate by feeding back to the grid of the 6SJ7. The resistor-condenser combinations of C_2R_1 and C_1R_2 determine the time element necessary for such a cycle to take place, which in turn determines the frequency of the oscillator. R_2

controls the amount of negative feedback necessary to reduce the gain of the 6SJ7 tube to approximately 1.

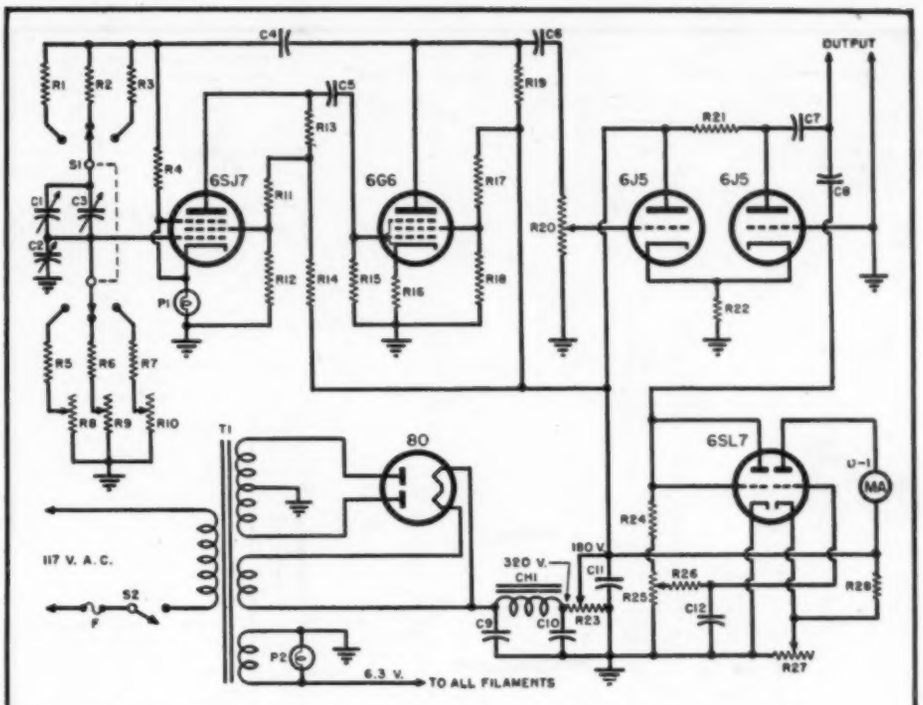
The 3 watt Mazda lamp in the cathode of the 6SJ7 creates a variable resistance which automatically adjusts the amount of negative feedback. The regulation created by this Mazda lamp causes uniform output from the oscillator over the entire frequency range. To detemine the capacities of C_3, C_4, R_1, and R_2, a reactance slide rule proves itself quite handy.

To select the approximate frequency, use the following procedure: Assume it is desirable to operate the oscillator at 400 cycles. We look in a condenser box and find that we have two .002 μfd. condensers. What value of resistance is required? The reactance of a .002 μfd. condenser at 400 cycles is approximately 200,000 ohms; therefore, C_3 and C_4 condensers become .002 μfd., and R_1 and R_2 resistors have a value of 200,000 ohms. Inserting these values in the circuit, the frequency should be close to 400 cycles. Commercial tolerances on condensers and resistors are such that exact frequency should not be expected. After the oscillator is put into operation with these values, it is only necessary to vary the resistors or the condensers to hit the exact frequency.

The next operation is to select the correct value of resistance for R_2. Insert a 10,000 ohm potentiometer in the place of R_2 and adjust this resistor as follows: Reduce the resistance until the oscillator stops oscillating. Next, increase the resistance slightly until oscillation starts. Without changing the setting of the 10,000 ohm potentionemeter, remove it from the circuit and check the resistance, inserting a fixed resistor of the same value.

The action of this adjustment is to feed sufficient negative feedback to the cathode of the 6SJ7 to reduce the gain to approximately 1. For minimum distortion output, the resistors and condensers of the *RC* network should be closely matched. A mismatch of 10% will cause harmonic distortion in the order of 5%. The coupling condenser C_1 must be larger than normally used in a resistance-coupled amplifier, since a small capacitor would cause phase shift. A .5 μfd. condenser should be considered minimum capacity. The feedback condenser C_2 must have a capacity of at least 5 μfd. due to the low load resistance created by the negative feedback circuit. If the oscillator is to be used for low frequencies, heavy condensers reduce the possibility of phase shift. If the oscillator is used at high frequencies (above 20,000 cycles), the capacity to ground of circuit components, wiring, and tube capacities becomes important in that this causes phase shift.

The use of a bath-tub type condenser for C_1 is undesirable, since the capacity of the condenser to the can will cause difficulties at high frequency. If phase shift is encountered at high frequencies, it can be corrected by using small capacities from the



R_1—10 megohm, ½ w. res.
R_2—1 megohm, ½ w. res.
R_3, R_{11}, R_{13}, R_{26}—100,000 ohm, ½ w. res.
R_4—2000 ohm, ½ w. res.
R_5—9.5 megohm, ½ w. res.
R_6—950,000 ohm, ½ w. res.
R_7—95,000 ohm, ½ w. res.
R_8—500,000 ohm rheostat
R_9—50,000 ohm rheostat
R_{10}—5000 ohm rheostat
R_{12}, R_{21}—47,000 ohm, ½ w. res.
R_{14}, R_{20}—10,000 ohm, ½ w. res.
R_{15}—500,000 ohm, ½ w. res.
R_{16}—100 ohm, ½ w. res.
R_{17}, R_{19}—10,000 ohm, 1 w. res.
R_{18}—33,000 ohm, 1 w. res.
R_{20}—500,000 ohm pot.
R_{22}—370 ohm, ½ w. res.
R_{23}—5000 ohm, 50 w. semi-variable res.
R_{24}—5000 ohm, ½ w. res.
R_{25}—1 megohm pot.
R_{27}—10,000 ohm rheostat
C_1—50 μμfd. var. cond.
C_2, C_3—1000 μμfd., ganged var. cond.
C_4—5 μfd., 400 v. cond.
C_5, C_6, C_7—.5 μfd., 400 v. cond.
C_8—.1 μfd., 200 v. cond.
C_9, C_{10}, C_{11}—20 μfd., 450 v. elec. cond.
C_{12}—.01 μfd., 200 v. cond.
P_1—3 w. lamp
P_2—6.3 v. pilot lamp
S_1—3 pole, 3 pos. rotary sw.
S_2—S.p.s.t. toggle sw.
F—Fuse
T_1—Power trans. 325-0-325 @ 50 ma., 6.3 v. @ 2 amp., 5 v. @ 2 amp.
CH_1—10 hy., 50 ma. filter choke
1—0-1 ma. d.c. meter
1—6SJ7 tube
2—6J5 tubes
1—6G6 tube
1—6SL7 tube
1—80 tube

Fig. 2. Schematic diagram of a.c. operated Wien Bridge type audio oscillator.

screens of the tubes to ground. The value of these capacitors will be determined by experimentation. If a variable frequency oscillator is desired, simply substitute a variable condenser for C_3 and C_4 and adjust the values of R_1 and R_2 so the frequency spectrum desired is covered.

It is common practice to use a four-gang variable condenser with two sections tied together for the variable control. If desirable, the capacitors C_3 and C_4 can be fixed and a dual potentiometer used for resistors R_1 and R_2 to vary the frequency. The use of potentiometers for the purpose is rare, since linearity is not certain. If a variable condenser is used, it is necessary to insulate the rotor from the chassis and compensate for the additional capacity to ground by shunting the same amount of capacity across the section that is above ground. By using a variable with a capacity of 450 μμfd. per section and

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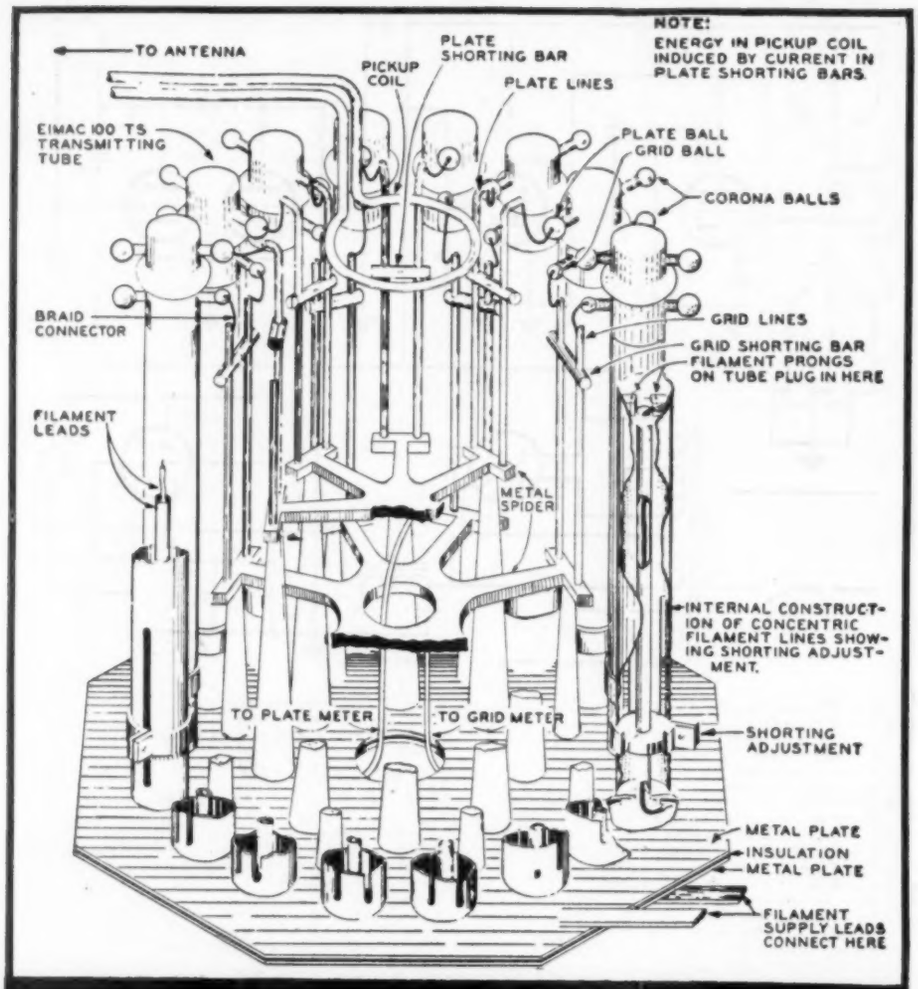
Panel view of RC oscillator shows position of various operating controls.



Cut-away drawing of typical ring oscillator used in Army Signal Corps radar equipment, SCR-268, showing circular arrangement of tube and circuit components in one method of construction.

Ring Oscillators for U.H.F. TRANSMISSION

A wartime development that contributes to the efficient operation of tubes at high frequencies, thus permitting high power outputs to be more readily accomplished.

By TOM GOOTÉE

GENERATION of u.h.f. oscillations above 300 megacycles is an impossible task for conventional types of vacuum tubes, because of the effects of interelectrode capacitance and electron transit time, and the effects of distributed inductance and capacitance in tube leads. Special types of high-frequency triodes—developed within recent years—have overcome some of these limitations to a degree, and many of the tubes can function as negative-grid oscillators at frequencies well beyond 1000 megacycles.

But these special triodes cannot carry large amounts of current, and therefore their output power is relatively low for most u.h.f. requirements. And the old bugaboo: interelectrode capacitance, though of lower magnitude, is *still* present. And it is *still* objectionable, since it limits the highest operating frequency of a vacuum tube.

The only solution to the problem of generating very high power with u.h.f. triodes is by arranging *an even number of them* in a wholly new type of u.h.f. oscillating circuit, known as a *ring oscillator*.

Any type of special u.h.f. triodes may be used in this arrangement, their combination providing not only a greater power output but also an extension of the *upper limit* of frequency operation in the u.h.f. band. Thus, an even number of four or more triodes will oscillate at higher operating frequencies and with greater power output than would be possible with one or two vacuum tubes of the same type.

Basically, the circuit is a special type of tuned-plate, tuned-grid oscillator.

The development of the ring oscillator is closely allied with the fundamental feedback circuit.

Basic Circuits

The circuit for the basic tuned-plate tuned-grid oscillator (Fig. 1A) uses a single vacuum tube and a resonant coil-and-condenser tank circuit in both grid and plate circuits.

Action of the oscillator is predicated on the feedback of energy from plate to grid circuits by means of the plate-to-grid interelectrode capacitance within the tube itself.

In operation, alternating voltage fed back to the grid of the triode is 180 degrees out-of-phase with the alternating voltage in the plate circuit, and the grid voltage is of sufficient amplitude to develop the output power required to maintain this voltage.

Frequency of oscillations is slightly *lower* than the resonant frequency of the plate and grid tank circuits. The two circuits need not be in exact resonance with each other, since frequency of oscillations is determined primarily by constants of the plate circuit. The grid tank circuit controls the degree of excitation.

At the operating frequency, both tank circuits offer inductive reactance

to the flow of current. But to sustain oscillations, reactance of the plate-to-grid interelectrode capacitance must be greater than the inductive reactance of the grid tank circuit.

Grid current in a tuned-plate, tuned-grid oscillator effectively leads the plate voltage by more than 90 degrees, so that voltage fed back to the grid of the tube is exactly in phase with the plate current. This satisfies the oscillator requirement of a *negative resistance* of magnitude sufficient to compensate for all losses in the circuit.

Fixed bias (such as a battery) is seldom used in feedback oscillators. Invariably used is resistance bias, so the circuit will be self-starting and stable operation will be ensured.

To obtain an output power greater than that for a single triode, two or more tubes may be connected in parallel. However, this serves no practical advantage, because all tube interelectrode capacitances are *also* paralleled. This increases the minimum circuit capacitance, decreases the tuning range, and causes the development of parasitic oscillations.

For these reasons, *parallel-connected oscillators are not useful for generating ultra-high frequencies.*

To obtain increased output and *also* greater frequency stability, a double-ended arrangement of the tuned-plate, tuned-grid circuit may be used. In this arrangement (Fig. 1B), two triodes of the same type are connected in push-pull.

Operation of this circuit also depends upon the interelectrode capacitance of each tube. Oscillations are sustained when a sufficient portion of the voltage in the plate circuit is fed back to the grid circuit.

The two triodes are balanced against ground, and each tube handles an alternation opposite in original polarity to that handled by the other tube—so that both alternations are utilized. In this way, even-order harmonics are effectively cancelled out in the plate circuit.

Oscillations normally tend to increase in amplitude until the energy lost in the grid and plate tanks is exactly equal to the energy supplied the tank circuits by the two triodes. Maximum amplitude of oscillations is called the *saturation amplitude,* since the two tubes are driven into the plate-current saturation region of their characteristic curves.

Since interelectrode capacitances of the two tubes are effectively *in series,* theoretically their combined value would be one-half that for a single triode — considerably extending the highest frequency at which the oscillator may be operated.

However, at ultra-high frequencies, the distributed inductance of the tube leads *which are also in series* tends to overcome the advantage of decreasing input capacitance.

Resonant Lines

Effects of distributed inductance and capacitance in circuit components directly associated with the oscillator can be minimized by using extremely short leads and *resonant lines.*

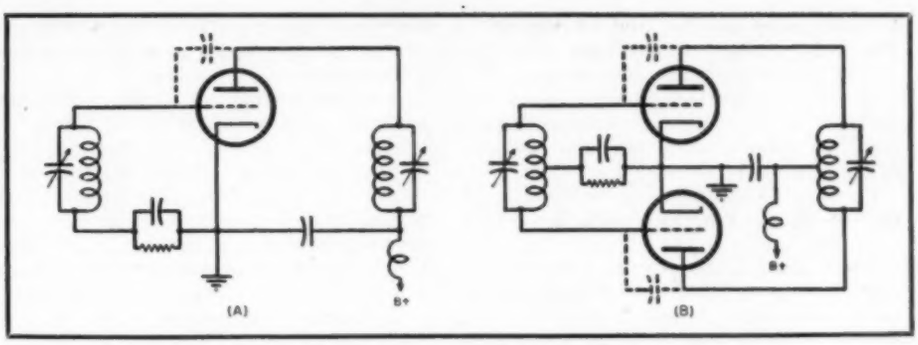


Fig. 1. Basic (A) and push-pull (B) tuned-grid, tuned-plate oscillators.

Use of resonant or Lecher lines also contributes to extreme frequency stability and increased power output of the tuned-plate, tuned-grid oscillator. This takes place because both output power and frequency stability are functions of the "Q" of the oscillator's resonant tank circuits. "Q" is a factor-of-merit, determining the sharpness of resonance of a tuned circuit.

Considering the basic push-pull circuit (Fig. 1B), to obtain a high "Q" required for efficient u.h.f. operation, the r.f. resistance must be low. This would require use of a very large conductor, since u.h.f. current flows only on the outer surface. Also essential is a large inductance, compared to the capacitance of the tank circuit. But this is practically impossible, since interelectrode capacitances of the tube are limiting factors. Therefore the "Q" of a coil-and-condenser tank circuit, even at best, leaves much to be desired for ultra-high frequency operation.

Quarter-wave resonant lines have very high values of "Q," and therefore are ideal as tuned tank circuits for ultra-high frequency operation. High values of "Q"—between 5000 and 10,000—are made possible by the construction of the resonant or Lecher lines, which minimize skin effect. As the operating frequency is increased, the length of the resonant line decreases faster than the skin effect increases. Thus, the value of "Q" increases with frequency of operation.

The basic push-pull circuit (See Fig. 1B) has been redrawn in Fig. 2, showing the substitution of tuned resonant lines for the previous coil-and-condenser tank circuits.

The circuit operates in much the same manner as the basic push-pull tuned-plate, tuned-grid oscillator. Differences are mainly physical or mechanical ones.

Grid and plate terminals of the two triodes are generally connected directly across the open end of their respective resonant lines. Since the high-"Q" circuit is also a high impedance device, direct connections permit the oscillator tubes to work into maximum impedance, thus delivering optimum power output.

The only disadvantage of resonant lines is the shunt-loading effect of the

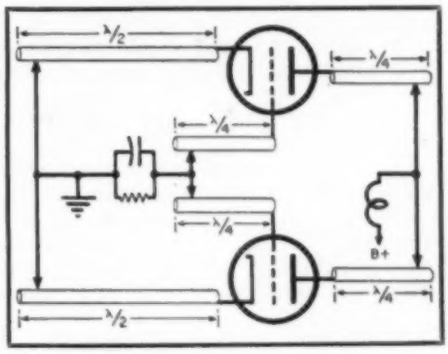


Fig. 2. Ultra-high frequency push-pull tuned-grid, tuned-plate oscillator.

triodes, which loads down the line and diminishes slightly the value of "Q."

Resultant operation is something of a compromise; high power output with relatively moderate stability.

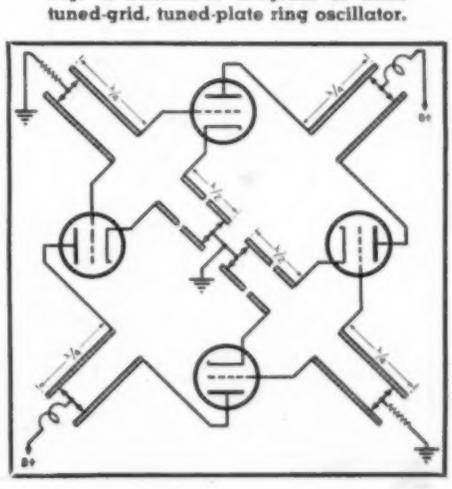
Tuning of resonant lines is accomplished by "shorting bars," which resonate the lines at a given operating frequency.

The u.h.f. energy can be coupled out of the push-pull resonant-line oscillator (Fig. 2) by inductive, capacitive, or direct connection.

Inductive coupling to the grid circuit—by means of a one-turn loop—is critical, because coupling may seriously reduce the "Q" of the grid resonant circuit to such an extent that frequency control is influenced.

Inductive coupling to the plate circuit results in an extremely high potential between the plate line and the one-turn coupling loop. This potential

Fig. 3. Schematic diagram of u.h.f. tuned-grid, tuned-plate ring oscillator.



is the sum of the d.c. and r.f. voltages. For this reason, precautions must be taken to prevent possible arcing. The degree of inductive coupling is often so limited that in some cases optimum coupling (maximum transfer of energy) cannot be obtained.

Capacitive coupling is seldom used unless in conjunction with inductive coupling.

It is possible to couple into a parallel line by tapping directly to one or both resonant lines, however, this should be done only to those lines carrying no d.c. voltage—such as the cathode or filament Lecher lines. Use of d.c. blocking condensers is discouraged.

These are general considerations of the simple push-pull resonant-line oscillator (Fig. 2).

The circuit has good stability of frequency.

Although it supplies a power output somewhat higher than any of the oscillators previously described, it is desirable in many u.h.f. applications to transmit signals of *much higher power*—while retaining good frequency stability.

The output power of the push-pull resonant-line oscillator (Fig. 2) is limited by the plate dissipation of the triodes and by the magnitude of plate current that can flow in the plate circuit.

Increasing the temperature of the filaments may permit greater emission, but this greatly shortens the life of the u.h.f. triodes, and is therefore undesirable.

A combination of four tubes arranged in *push-pull parallel* would increase the current-carrying capacity of the oscillator. However, the combined interelectrode capacitance would *also* be increased by such an arrangement, and parasitic oscillations would be prevalent. So, despite a higher output power, the upper limit of frequency operation would be limited and general efficiency of the circuit would be only fair. For this reason, use of the parallel push-pull oscillator for ultra-high frequency work *should be avoided.*

Solution of the problem of generating high power of stabilized frequency —with u.h.f. triodes—is a development of the simple push-pull resonant-line oscillator. This new circuit is known as a *ring oscillator,* and consists *of any even number of four or more* of the same triode types arranged concentrically and tuned with resonant lines.

Basic Ring Oscillator

The simplest type of ring oscillator consists of four tubes, arranged as shown in Fig. 3. Fundamentally it functions much as any tuned-plate, tuned-grid oscillator—using resonant or Lecher lines.

Leads between plates and grids of adjoining tubes connect to quarter-wave resonant lines. A common transmission-line tank serves each pair of grids and each pair of plates.

Standing waves of voltage established on sections of the tuned Lecher lines cause the instantaneous voltage on one plate to be 180 degrees out-of-phase with the connecting plate.

This voltage relationship *plus* some inductive coupling inherent between plate and grid circuits *plus* feedback of alternating voltage through the interelectrode capacitance of each tube *combine* to produce the necessary conditions for sustained oscillations.

Quarter-wave grid and plate lines are tuned to resonance by adjusting the position of the shorting bars. At resonance these shorting bars will be at zero r.f. potential.

Half-wave Lecher or coaxial lines are used in the cathode or filament circuit. When tuned to resonance, there will be zero r.f. potential both at the filament and at the shorting bar of each line.

In practice, electrical length of the resonant lines varies considerably from the physical length—because of capacitance effects between the various leads and r.f. ground potential, and between the tube elements and ground. This additional capacitive reactance in the circuit results in resonant lines of physical length considerably *shorter* than the effective electrical length.

Operating frequency of the ring oscillator is varied by adjusting the length of the resonant lines of all three tube circuits; grid, plate, and filament or cathode. The plate and grid resonant lines have the greatest effect on the oscillator frequency.

The u.h.f. energy can best be coupled out of the 4-tube ring oscillator by a single-turn coil placed between, in the same plane, and in close proximity to the two shorting bars of the plate circuit.

Since polarity of the plate resonant lines is in the same direction, current flows in the same direction in each line, and since the resonant lines are a quarter-wave in length and shorted at one end, current will be maximum at the two shorting bars *and flowing in the same relative direction.* This permits easy coupling by induction. The one-turn coil functions much as the secondary of an air-core transformer, feeding energy directly to the u.h.f. antenna by any kind of low-loss transmission line.

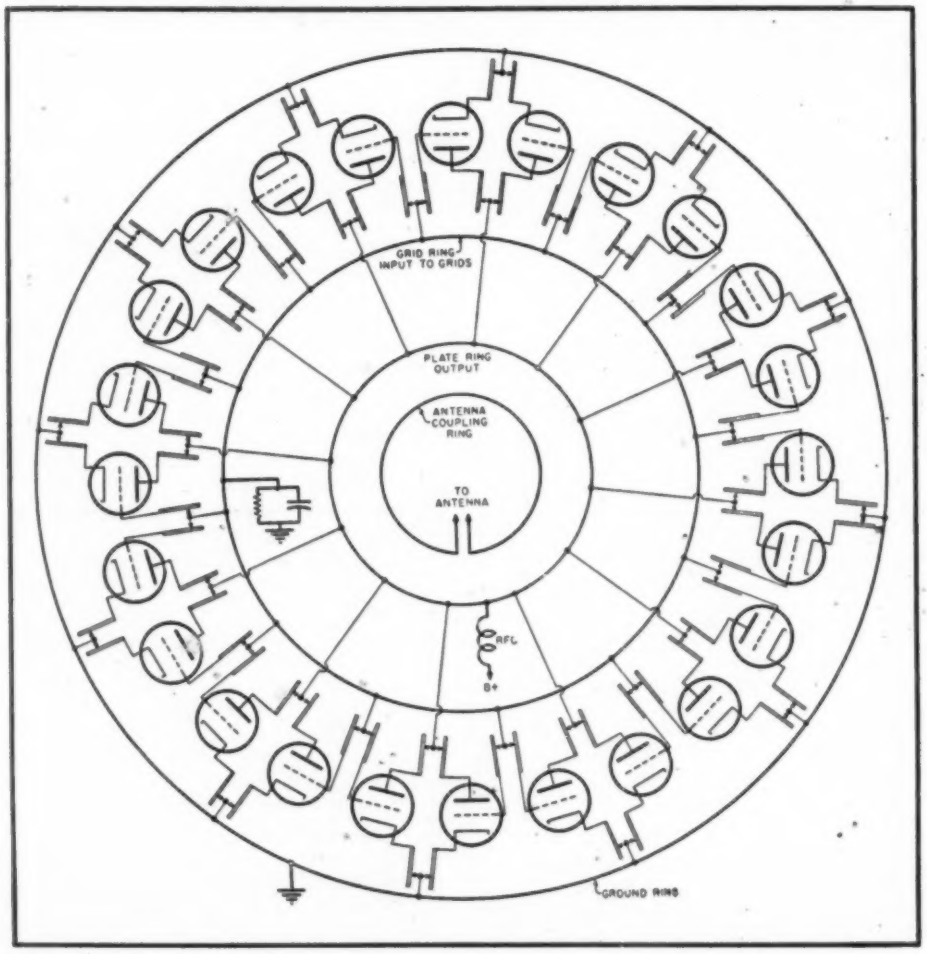
Frequency stability of this type of oscillator is good, and is generally independent of the type of u.h.f. triodes employed in the ring circuit.

The arrangement of four tubes provides a power output *double* that for two triodes (of the same type) arranged in a simple push-pull resonant-line circuit.

Since the tubes are effectively *in series,* the effect of interelectrode capacitance is diminished—permitting operation of the ring oscillator at a higher ultra high frequency than

(*Continued on page* 118)

Fig. 4. Wiring diagram of 24-tube u.h.f. ring oscillator.



Dealers are turning to complete demonstration of their merchandise. Improper use and knowledge of the appliance will cause "customer headaches."

A satisfied customer is the best advertisement a dealer can obtain. Remember however, that although the radio combination may be one of the best, poor installation will send your customer to your competitor.

Be Sure of Quality BEFORE YOU SELL

By
M. KENNETH BRODY*

A dealer's reputation is always at stake. High-quality home performance of all products will assure satisfied customers.

AS YOU read this, the first slow trickle of radios and appliances reaching your store is starting to increase to a stream. Soon the stream will widen to a river and soon after that we may expect flood tide. What will your position be when the flood is on us? If you use care and caution in building your dikes you will weather the flood and be strong. If you get careless and try just to ride the crest of the wave, you will be weak.

There are a few, and I feel a very few, dealers who have gone into the radio and appliance business with the fond hope of making a quick killing, taking the cream off the business, and then getting out. The words of advice and caution that follow are not for these. They are for the good, reliable dealers who have been in business for years and intend to remain in business. They are also for the veteran and many other reliable persons who have set up a radio and appliance business with the thought of continuing in business by being an asset to the community.

Let us first see what makes a good radio and appliance dealer. I think the following are the two most important factors, although there are many others:

1. A Good Product
2. Good Service

This brings us to the point of "What is a good product?" In my thoughts a good product is, "A piece of merchandise that, for the lowest possible price, will do, in the best possible manner, the job for which it is intended."

It must require a minimum of attention and service. When service is necessary, it must be easy to work on and the manufacturer or jobber must have adequate parts stocks available.

"Good Service" is much more than repairing a defective product when it needs repairing. "Good Service" starts before the customer enters your store and extends the life of the product you sell to him. "Good Service" gets your customer; "Good Service" keeps him sold; "Good Service" makes him a repeat customer and "Good Service" makes customers out of his friends.

As I said before, "Good Service" starts before the customer enters your store. When you send a circular, for example, on a new refrigerator to a person who has one that is ten years old, you are attempting to improve his living conditions and save him money on operation costs. This starts your "Good Service." When he comes in to buy, you make sure that he buys something he really needs; for example: when a man comes in to buy a water heater, sell him the correct size

(*Continued on page* 128)

* Former Technical Director, McCall's Test Rooms, McCall's Magazine.
Chairman, Committee of Domestic and Commercial Applications, American Institute of Electrical Engineers.

Putting the new SMALL METER to work

By
RUFUS P. TURNER, W1AY
Consulting Eng., RADIO NEWS

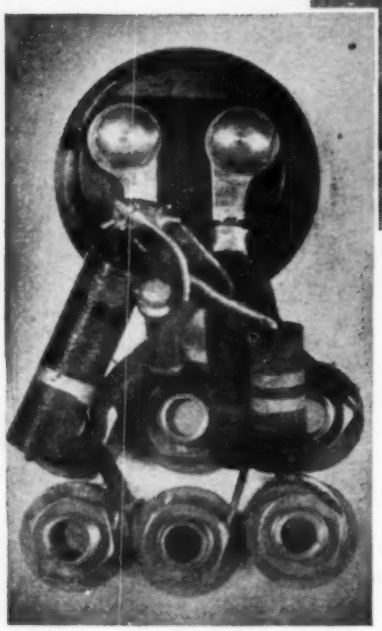


Fig. 1. Front and rear views of vest-pocket multi-range d.c. voltmeter, using a 1-inch 0-1 d.c. milliammeter. Ranges provided are 0-1, 0-10, 0-100, and 0-1000 d.c. volts and 0-1 d.c. milliamperes. Circuit schematic is given in Fig. 2. Size of the complete instrument is 2⅞" by 1-11/16" and ⅞" deep.

These meters make possible, for the first time, real pocket test instruments and complete sub-miniature radio transmitters.

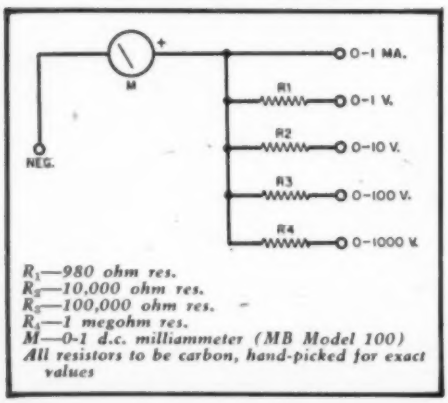
IN comparatively recent months, an Eastern instrument manufacturer[1] has made available to the public an interesting line of miniature panel-mounting meters developed during the war. Of the movable coil type, these instruments, in the round case style, are only 1 inch in diameter (the same size as that of a man's round-face wrist watch) and are available in all standard d.c. ranges from 0-100 microamperes to 0-10 milliamperes. Rectifier-type a.c. instruments are available in 1½-inch cases. Although the meter scales are small, they are perfectly readable without magnification.

These meters are fast and rugged and excellently damped, despite their small size, and are sealed against dust and moisture. Provided with powerful Alnico No. 5 magnets, soft iron pole pieces, and steel pivots in sapphire bearings, they conform to AWS specifications. The accuracy of all scale points is plus or minus 2% of full-scale deflection.

The new sub-miniature meters are of particular interest to radio amateurs, experimenters, and servicemen who plan to build pocket-size test instruments and midget communications gear. Heretofore, it has been possible to build equipment much smaller in size than available meters. In fact, a well-known paradox has been the "vest-pocket" transmitters and field strength meters that were as big as the then smallest available milliammeters. There really was little point in reducing dimensions of the instruments so drastically when provision had to be made for a space-hogging meter.

Sub-miniature test instruments and radio gear are more than mere curiosities. A reliable vest-pocket test meter is a distinct asset to the stairs-climbing serviceman already bogged down with a tool kit and other heavy paraphernalia. And the traveling radio ham has strong praise for a practical camera-sized transmitter or transceiver, *complete with tuning meter,* which will not noticeably increase his baggage burden as he approaches some distant hotel. Likewise, the ham at home appreciates the opportunity of keeping his monitors, frequency meters, and field strength meters small—for easy portability and minimum storage space.

Fig. 2. Circuit diagram of the test instrument illustrated in Fig. 1.



R_1—980 ohm res.
R_2—10,000 ohm res.
R_3—100,000 ohm res.
R_4—1 megohm res.
M—0-1 d.c. milliammeter (MB Model 100)
All resistors to be carbon, hand-picked for exact values

Applications

It would not be practical in a single article to give examples of all amateur and service applications of the new miniature meters. Only two applications actually are illustrated here, but these should arouse interest and stimulate further developmental work in this direction.

Radio service applications might include pocket voltmeters, milliammeters, ohmmeters, and multimeters, v.t. voltmeters, wattmeters, impedance meters, null indicators for bridges, decibel meters, continuity testers, first-step tube testers, microfarad meters, inductance checkers, battery checkers, and the like.

Amateur radio applications might include field strength meters, radiophone monitors, per-cent modulation meters, external or internal S-meters or tuning indicators for receivers, neutralizing indicators, volume level indicators, milliammeters on midget transmitter panels, indicating meters in absorption wavemeters—especially u.h.f., etc.

Figs. 1 and 2 show a real vest-pocket, multi-range d.c. voltmeter. The basis of this 1000 ohms-per-volt instrument is an *MB* Model 100, 0-1 d.c. milliammeter having an internal resistance of approximately 20 ohms.

[1] The MB Manufacturing Co., Inc., 331 East St., New Haven 11, Conn.

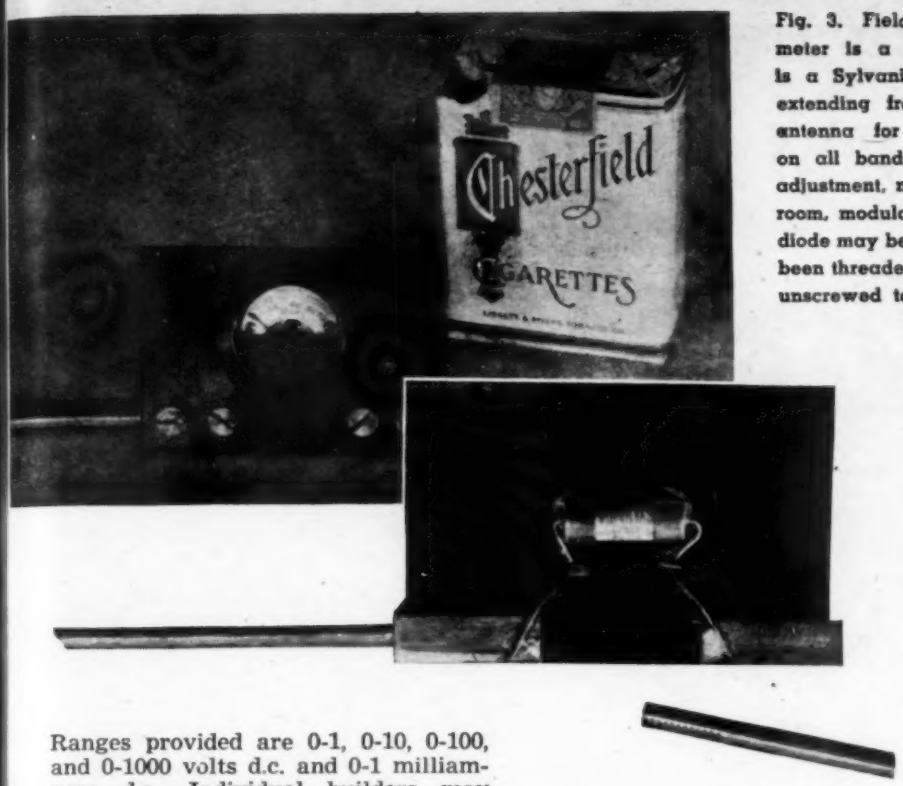


Fig. 3. Field-strength meter built by W1AWD. The indicating meter is a 1-inch 0-200 d.c. microammeter and the detector is a Sylvania 1N34 crystal diode. The removable brass rods extending from each side of the instrument form a doublet antenna for signal pickup. Excellent operation is obtained on all bands and the instrument has been used for antenna adjustment, neutralizing adjustments, transmitter tuning across the room, modulation monitoring, and stray r.f. detection. The crystal diode may be seen connected to two small brass blocks which have been threaded to admit the dipole antenna rods. One rod has been unscrewed to show ease with which antenna may be removed.

Ranges provided are 0-1, 0-10, 0-100, and 0-1000 volts d.c. and 0-1 milliampere d.c. Individual builders may provide other ranges and may include a.c. voltages and additional milliampere ranges as well.

The instrument panel, as shown in the photographs, is 1/16-inch-thick wire-brushed aluminum 2⅞" high and 1 1/16" wide. The mounting box is ⅞ inch deep. This voltmeter is in the featherweight class.

Multiplier resistors (See Fig. 2) are small-sized 1-watt carbon units, hand-picked for *exact* resistance values. The free-point contact terminals are standard sized, insulated banana jacks which accommodate the banana plugs on standard meter test leads.

The instrument size could have been reduced still further if smaller contact jacks had been obtainable. Also, a subminiature rotary switch would have permitted internal switching of the meter ranges. These are needed components which undoubtedly will be manufactured when widespread use of the small meters justify their production.

The test meter, taking up not quite as much room as the package of cigarettes alongside which it is shown in Fig. 1, fits into the serviceman's pocket with equal ease.

Figs. 3 and 4 show a universal field strength meter, using an *MB* Model 100, 0-200 d.c. microammeter, having an internal resistance of approximately 510 ohms. This instrument, built by A. R. Pierce, Jr., W1AWD, has been used already for adjusting beam antenna elements, neutralizing transmitters, watching for carrier shift in a 'phone transmitter, detecting stray r.f. energy in the shack and on power lines, and checking polarization of transmitted signals in the neighborhood of the transmitter.

As will be seen from Fig. 4, the instrument consists of a detector and indicator connected to the center of a small doublet antenna. The aperiodic detector is a *Sylvania* 1N34 crystal diode. The antenna is a rigid dipole composed of two 24-inch lengths of 3/16-inch-diameter brass rod. Although the antenna appears to be a half-wave at 233.7 megacycles, the field strength meter has been employed successfully at wavelengths as high as 80 meters. Either or both antenna rods may be removed by unscrewing from a small brass mounting block on the instrument panel.

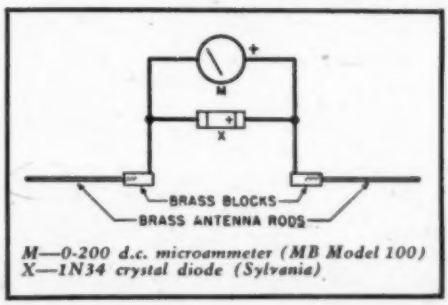
The entire instrument, with its pickup antenna, may be rotated easily in any plane when waves of various polarizations are encountered. In a recent test, as the operator walked by a large nearby metal body while reading the field strength meter, rotation of the antenna from vertical to horizontal meant the difference between no indication at all and better than full-scale deflection of the microammeter.

In certain applications involving close proximity of the field strength meter and transmitter, as when watching for carrier shift on a radiophone signal with the transmitter across the room, the dipole antenna will pick up excessive r.f. energy and the meter pointer will be driven vigorously against the pin. Pickup may be reduced in such a case by unscrewing and removing one of the antenna rods, as shown in Fig. 3.

If an individual builder desires, he may include in the midget field strength meter a tuning circuit, comprised of a midget variable capacitor and miniature plug-in coils. Tuning capacitors now are available in very small over-all sizes, and plug-in coils may be wound on tiny forms. Fig. 5 is a suggested circuit diagram for a tunable instrument.

If the dial of the tuning capacitor is graduated in megacycles, the instrument will be invaluable as a direct-reading absorption wavemeter, as well as a field strength meter, modulation checker, and neutralizing indicator.

Fig. 4. Circuit diagram of the field-strength meter shown in Fig. 3. The brass antenna rods are 3/16 inch in diameter and 24 inches in length.

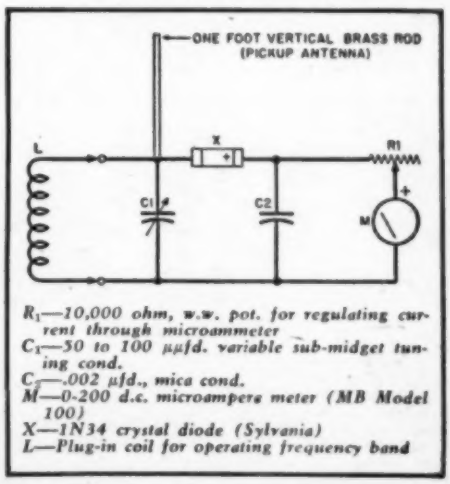


M—0-200 d.c. microammeter (MB Model 100)
X—1N34 crystal diode (Sylvania)

On the Way

With sub-miniature batteries and tubes now available, the possibilities offered by the new miniature microammeters for construction of a single-packaged pocket v.t. voltmeter are not easily ignored. The author now is at work on such an electronic voltmeter. There is every indication that the developmental work soon will be completed, and it is planned to describe the instrument in this magazine. -30-

Fig. 5. Suggested circuit for a tuned field-strength meter.



R_1—10,000 ohm, w.w. pot. for regulating current through microammeter
C_1—50 to 100 μμfd. variable sub-midget tuning cond.
C_2—.002 μfd., mica cond.
M—0-200 d.c. microampere meter (MB Model 100)
X—1N34 crystal diode (Sylvania)
L—Plug-in coil for operating frequency band

Home Constructed V.T.V.M.

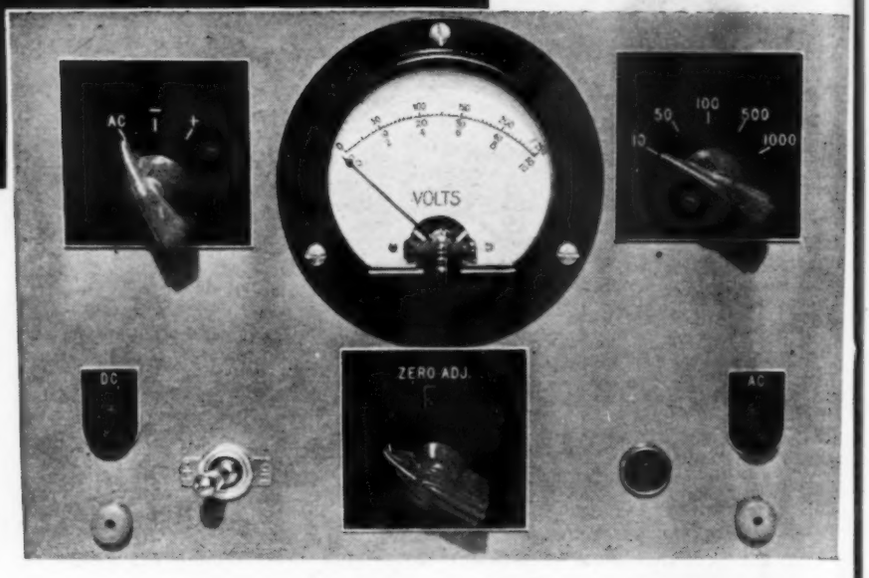


Fig. 1. Front panel view of completed test instrument. The meter can have a movement anywhere from 50 microamperes to 1 milliampere.

By
J. H. CARLISLE

Design and construction of an extremely simple vacuum tube voltmeter. It can be built by the novice with a small cash outlay.

THERE have been published in all leading magazines, from time to time, vacuum tube voltmeters of every size, shape and description. We propose to describe a simple vacuum tube voltmeter which requires essentially, one tube, exclusive of the power supply rectifier, and in which the builder may use anything from a 0 to 50 microammeter to a 0 to 1 milliammeter.

In the model described, a VR150 tube is included in the interest of greater stability. This, however, is a refinement which is not essential to its operation. The circuit is shown in Fig. 2, and consists of a bridge with a tube as one arm. The tube is operated practically as a cathode follower and is highly degenerative. This high order of degeneration is instrumental in providing the great stability of the circuit. If you wish to look at the circuit another way, it consists of a cathode follower and the voltage is read across its cathode by means of a meter whose other side is connected to the proper voltage to buck out the initial reading on the meter caused by the no signal current in the tube and thus allows the needle to be set to zero.

One of the greatest advantages of using the cathode follower is the fact that it loads a circuit under test very slightly. There are two causes of loading when a tube's grid is connected to a circuit—capacity and grid current. In a cathode follower, the input capacity is degenerated to a value approximately equal to the measured input capacity of the tube, instead of being equal to the input capacity of the tube times mu, as it would be in the conventional circuit with the load in the plate circuit of the tube. Grid current can be prevented by inserting sufficient series resistance in the grid circuit to keep any current drawn by the grid very low, in the order of a fraction of a microampere. This is the function of the 3 megohm resistor R_6 in Fig. 2.

The main objective in a vacuum tube voltmeter is to provide a voltmeter which loads the voltage to be investigated as slightly as possible, i.e. it draws as low a current from the investigated source as is feasible. There is a limit, however, to the value of resistors which are readily available to the average service man or experimenter, so we have set 10 megohms as the total input resistance for the instrument (the effective a.c. impedance is 6.3 megohms). This gives a one-million-ohms-per-volt instrument on the 10 volt scale which means for full scale deflection on a 10 volt scale it will draw one microampere.

On the 50 v. scale it draws 5 microamperes. These currents may not be considered appreciable for any measurements encountered in service work or general experimenting.

The 6SN7 has been chosen as an appropriate tube for our circuit, first because it contains two complete triode sections; second, because it is easily obtainable; third, because its plate characteristics are nearly straight lines. The first section of the 6SN7, V_1, is connected as a diode to act as a rectifier so that the meter can be made to read a.c. voltages. It is highly desirable in order to reduce confusion, to have the voltmeter read either a.c. or d.c. on the same scale, so the diode is connected, as shown in Fig. 2, to read a peak value of a.c. voltage and then a resistor is inserted to act as a voltage divider with the 10 megohm divider on the a.c. voltmeter circuit. In this way the meter will read the r.m.s. value instead of peak. This is also the reason a scale of lower than 0 to 10 volts was not included, as the diode imparts a serious enough nonlinearity to require a separate scale for any a.c. scale lower than 0 to 10. The layout and construction are apparent from the photographs (Figs. 1, 3, and 4).

The VR150 tube holds the plate voltage on V_2 constant with line voltage changes, although, due to its high order of degeneration, V_2 plate current does not change more than a few per-cent with a considerable change in plate voltage. It is suggested that if the VR150 is not used, it should be replaced with a 10 watt resistor of such value as to provide 150 volts on the plate of V_2.

The author used a 0 to 50 microammeter as the indicating device on his model. However, it was found that a 0 to 100 or 0 to 200 microammeter could be used while maintaining the extremely good linearity. The instrument, as shown with 50 microampere meter, was so linear that a scale was drawn and divided with a compass. When checked with known voltages, there was no departure from linearity greater than the width of a line forming the divisions on the scale.

A 0 to 0.5 milliammeter can be used

with a slight nonlinearity. When a 0 to 1 milliammeter is used the departure from linearity is serious enough to require the scale to be hand calibrated. This is not as difficult as it sounds. All the equipment that is needed for such a calibration is two flashlight cells and one 45 v. "B" battery. With these voltage sources, and a few resistors of known value, all the scales can be calibrated. The nonlinearity will be precisely the same for all ranges, so only one range must be calibrated as the others may then be drawn in.

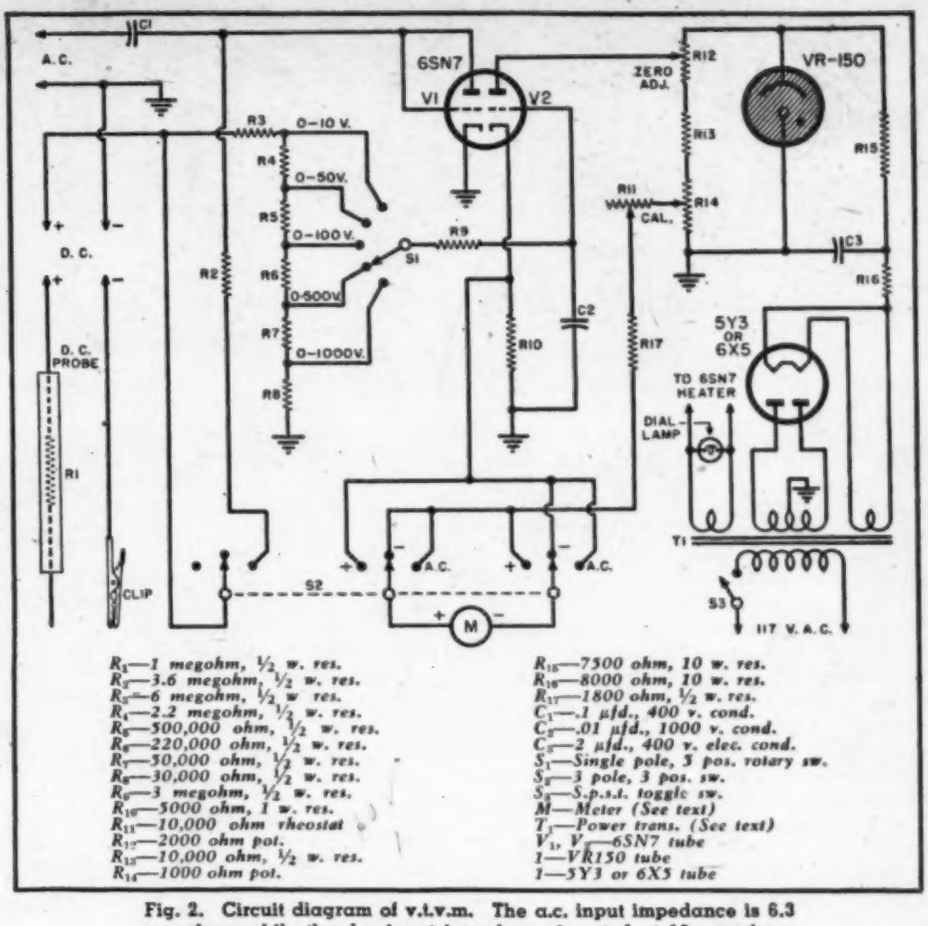
It is suggested that the 10 v. scale be chosen for the calibration and then 6 flashlight cells connected in series will give sufficient points to construct the scale, i.e. 1.5 v., 3 v., 4.5 v., 6 v., 7.5 v., 9 v. (actual voltage of a new cell is somewhat higher than 1.5 v., on the order of 1.55 v.).

If the more sensitive meters are used, the scale can be constructed directly with a compass. The author constructed his scale on a piece of 8" x 10" paper. This enlarged scale was then photographed and a print made from the resulting negative which was precisely the right size to fit the 3" meter used in the model. This photographic reduction minimizes the imperfections in the drawn original and results in a scale which looks as if it had been printed. A box camera may be pressed into use in lieu of a focusable model, and a +3 portrait attachment used in front of the lens. The picture can be made from a distance of about two feet which will result in a very acceptable scale. Of course, the scale may be drawn directly on a piece of paper or cardboard and glued directly over the existing meter scale, or a meter may be purchased with the scales on it. The reproduction (Fig. 5) of a scale for a 3" meter may be traced or cut out and pasted on the meter face.

The ranges chosen by the author are 0 to 10 v., 0 to 50 v., 0 to 100 v., 0 to 500 v., 0 to 1000 v. Any number of intermediate values can be used by providing the proper taps on the voltage divider. It is not recommended that the 1000 v. a.c. scale be used, as 1000 v. is too high a voltage to apply to the 6SN7 diode connected rectifier.

The resistors in the divider should be as accurate as possible. If you can obtain 1% precision resistors, they should be used; if not, 5% metalized 1-watt resistors will do. If greater accuracy than 5% is desired, the values may be obtained by a series or parallel connection of two or more resistors to make up each of the six resistors in the divider. If an accurate ohmmeter is available, the resistors may be pruned after the instrument is built, by applying known voltages and adjusting the resistor until the scale reads properly. The calibration pot should be set on the 10 v. scale so that a known voltage of 3 volts reads 3 v. on the 10 v. scale. After each change in the divider, the 10 v. scale should be checked to be sure its calibration has not been affected. If it has, readjustment of the calibration pot is necessary. The zero adjusting pot which is located on the front

(*Continued on page* 84)



R_1—1 megohm, ½ w. res.
R_2—3.6 megohm, ½ w. res.
R_3—6 megohm, ½ w res.
R_4—2.2 megohm, ½ w. res.
R_5—500,000 ohm, ½ w. res.
R_6—220,000 ohm, ½ w. res.
R_7—30,000 ohm, ½ w. res.
R_8—30,000 ohm, ½ w. res.
R_9—3 megohm, ½ w. res.
R_{10}—5000 ohm, 1 w. res.
R_{11}—10,000 ohm rheostat
R_{12}—2000 ohm pot.
R_{13}—10,000 ohm, ½ w. res.
R_{14}—1000 ohm pot.
R_{15}—7500 ohm, 10 w. res.
R_{16}—8000 ohm, 10 w. res.
R_{17}—1800 ohm, ½ w. res.
C_1—.1 µfd., 400 v. cond.
C_2—.01 µfd., 1000 v. cond.
C_3—2 µfd., 400 v. elec. cond.
S_1—Single pole, 3 pos. rotary sw.
S_2—3 pole, 3 pos. sw.
S_3—S.p.s.t. toggle sw.
M—Meter (See text)
T_1—Power trans. (See text)
V_1, V_2—6SN7 tube
1—VR150 tube
1—5Y3 or 6X5 tube

Fig. 2. Circuit diagram of v.t.v.m. The a.c. input impedance is 6.3 megohms while the d.c. input impedance is rated at 10 megohms.

Fig. 3. Under chassis view of completed test instrument.

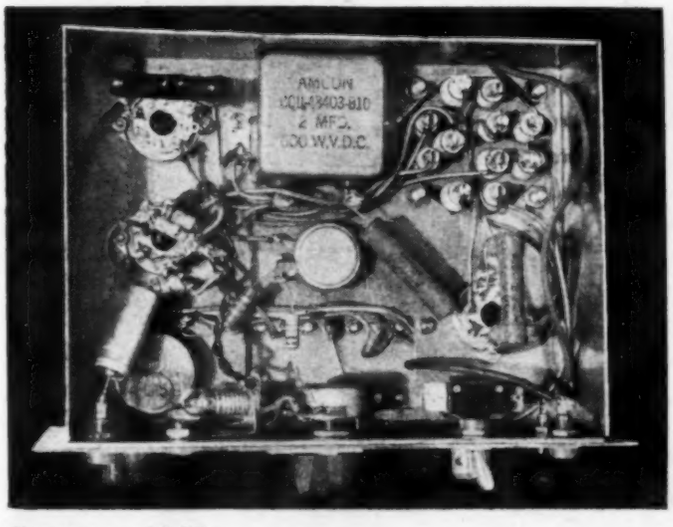
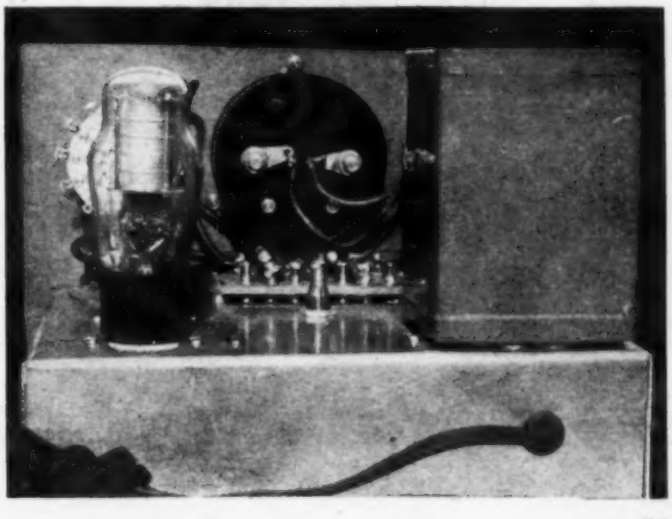
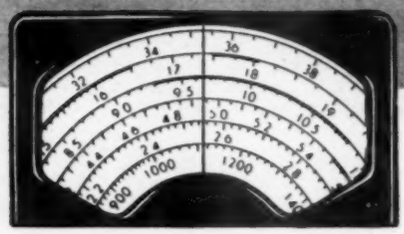


Fig. 4. Rear view shows neatness of above chassis layout.



International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

SHORT-WAVE enthusiasts the world around can look forward to 1947 with few misgivings. I believe they can face the New Year with hope of better reception to come.

Short-wave radio is rapidly coming of age. The results of wartime research and invention should be more evident in both broadcasting and receiving equipment in the years immediately ahead. Too, we can expect expanded facilities and schedules as well as better programming. Many new stations—from New Zealand to Northern Europe to Central Africa and back to Java—will, in all probability, take to the airwaves this year.

Broadcasting experiences during World War II have clearly demonstrated the effectiveness of short-wave radio and that it should prove an ideal medium in helping to achieve and maintain better understanding between the nations of the world. *In no other way can the spoken word reach so many people in so short a time.* In no other way can one tell one's story so quickly either to or from the more remote places on the globe. I, for one, feel strongly that international short-wave radio *will* assume its rightful place and responsibility in the era just beginning.

Since war's end there have been many complaints regarding the poor quality of receivers in general—and of the component parts thereof, including tubes, in particular—but as production increases and demand tends to lessen, in all likelihood, manufacturers will put more stress on "quality" as well as "quantity" production.

Last, but not least, scientists predict that during a part of 1947 we should have some respite, perhaps brief, however, from sunspot activity that was so annoying to short-wave listeners during the past year.

All in all, we can anticipate brighter listening days (and nights!) ahead for us all.

* * *

Uruguay's CXA19

Through the courtesy of John Znaidukas, Philadelphia, this month we present information regarding short-wave station CXA19, located in Montevideo, Uruguay, South America:

CXA19 operates with a power of 5000 watts, is listed on 11.835, but in a letter to Mr. Znaidukas, an official of the station indicated the current frequency as 11.705. *"El Espectador,"* as the station is known, has been experiencing quite a bit of interference lately and has been sending out requests for information on said interference, in order that data may be submitted to the Government of Uruguay in the hope of receiving a new allocation of frequency.

Schedule is 6 a.m. to around 10:05 p.m. sign-off *daily.* Apparently, all transmissions are in Spanish.

This station uses a full-wave horizontal antenna, beamed to the United States and to Europe; the transmitter was made locally, having been designed by the technical staff of CXA19 and then was constructed in the station's own workshop. The transmitter was assembled as two units—one-kilowatt plate modulated exciter and a five-kilowatt radio frequency linear amplifier, which is equipped with two Marconi CAT-9 tubes.

Mr. Znaidukas received his verification and some photographs from CXA19 two months after mailing in his reception report. The letter was signed by Sr. Jorge Cobilo, el Gerente General. Address is "El Espectador," Difusoras del Uruguay, La Cadena Uruguaya de Radiodifusion, 1393, La Sociedad Anoima, Montevideo, Uruguay.

In reporting to this station, it is suggested that full information be furnished regarding any interference noted.

* * *

Sunspots to Continue

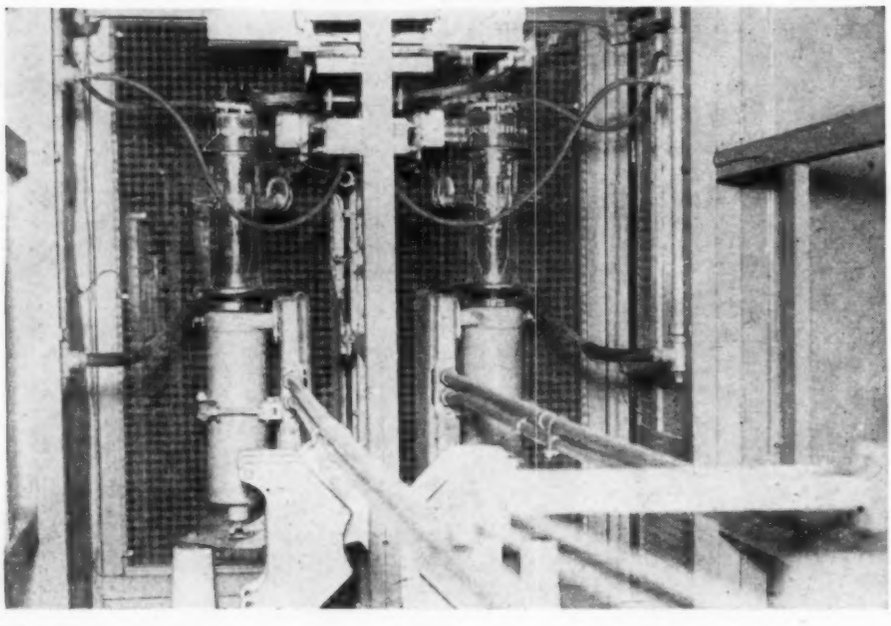
According to Dr. John Q. Stewart, Princeton University astronomer, sunspots, some of them as big as the earth, will continue to disrupt radio, wireless, and telegraph facilities for at least another year. Even then the world will get only a comparatively brief respite from this solar phenomenon. One spot cycle is just completed and then another one starts. It usually takes about 11 years for the maximum to be reached.

Dr. Stewart, professor of astronomical physics, and George S. Baldwin, Jr., a Princeton undergraduate, recently devised a formula on which they based the prediction that the present cycle of sunspots would reach its maximum by about the end of 1947. (Havlena)

Of interest to ISW listeners will be this comment by a BBC engineer in a recent issue of *"London Calling":*

"Sunspot activity continues to increase very rapidly, and the effect of this upon the ionosphere seems likely soon to have definite repercussions upon short-wave transmission and re-

View of power amplifier, showing the two Marconi CAT-9 tubes and line plate circuit, at station CXA19, Montevideo, Uruguay, South America. The station is currently operating on 11.705, 6 a.m.-10:05 p.m., EST.



Unless otherwise indicated, all time herein is in *Eastern Standard Time,* 5 hours *behind* GMT.

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- HANG ON WALL—SET ON SERVICE BENCH
- INDIVIDUAL, IDENTIFIED COMPARTMENTS
- ATTRACTIVE YELLOW, BLUE AND SILVER FINISH
- FACTORY PACKED

NEW IRC RESISTOR KIT CONTAINS COMPLETE VARIETY OF STOCK NEEDED FOR YOUR DAY TO DAY WORK!

Basic Kit Contents

160 IRC Type BTS New, ½ watt *metallized* filament Resistors
115 IRC Type BTA New, 1 watt *metallized* filament Resistors
35 IRC Type BT-2 2 watt—*metallized* filament Resistors
60 IRC Type BW-½ ½ watt—wire-wound Resistors
20 IRC Type BW-1 1 watt—wire-wound Resistors
20 IRC Type BW-2 2 watt—wire-wound Resistors
22 IRC Type AB 10 watt Power wire-wound adjustable Resistors
16 IRC Type ABA 10 watt Power wire-wound adjustable Resistors
6 IRC Type EPA 50 watt Power wire-wound adjustable Resistors
7 IRC Type ESA 80 watt Power wire-wound adjustable Resistors
6 IRC Type X-3 Bands—additional bands for adjustable Resistors
2 IRC Type MW-2J Bleeder-type Resistors
2 IRC Type M-1034 Bleeder-type Resistors

Free! Neat, Handy, All-Metal Cabinet free with Basic Kit of resistors ordered at standard resistor prices. Cabinet is not sold separately.

● *YOU* ASKED US FOR IT! HERE IT IS! THE IRC *BASIC* KIT—a wide-variety stock of most-needed resistor sizes and types that equips you to do just about any job you'll encounter in your day to day work. This unusually handy and convenient assortment of items was carefully selected through an exhaustive study of orders and a survey of IRC distributors and dealers.

The IRC Basic Kit is a practical planned time-saver, particularly suited to the needs of servicemen, schools, colleges, research labs and Industrial Maintenance Departments. The Resistor Assortments are so arranged that in most cases even a shortage of stock in any *one* range may be compensated for by using two other ranges in series or parallel. The power wire wound resistors included are useful in replacing many power resistors used in old-time receivers and as ballast resistors in some of the more modern AC-DC receivers. Additional adjustable bands are included in the Kit for use in making up bleeder sections.

IRC — PIONEERED FOR PERFORMANCE — FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

401 N. BROAD ST., PHILADELPHIA 8, PA.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

ception. The present sunspot cycle, in fact—judging by the course of events since its minimum in April, 1944—promises either to give rise to solar activity of exceptional magnitude, or else to reach its maximum in an unusually short time. Already, only two years or so after the minimum, the activity has reached levels comparable to those of about four years before it, and this rapid increase shows no sign of abatement." *(This statement was made prior to the increased sunspot activity experienced widely during September, particularly during the latter half of that month.)*

The BBC engineer continued, "Concurrent with the increase in solar activity, and owing, of course, to its effects, there has been a rapid increase in the electrification or 'ionization' of the upper atmosphere. And as it is the degree of ionization of this region —the 'ionosphere'—that determines the frequencies suitable for short-wave communication at any particular time of day, this increase of ionization must be taken careful account of when selecting the frequencies to be used.

"During the northern hemisphere summer months, however, there is a seasonal effect in the ionization which, so far as the daylight hours are concerned, counteracts that caused by the solar cycle. As the autumn equinox approaches, this seasonal effect will cease to act against the solar cycle effect, and the full increase in the ionization will become apparent. In short —in September of 1946 listeners to the BBC may expect some extensive changes in the frequencies they receive best.

"When the ionization is high, the highest frequencies (shortest wavelengths) become of the greatest utility; when it is low the reverse applies. So, from September onwards the tendency will be to make greater use of the higher frequencies for transmission over daylight paths, and this situation will probably hold good throughout the northern winter. So far as the night-time frequencies are concerned, these will probably decrease somewhat from September towards the midwinter period, but even so they will often be considerably higher (wavelengths will be shorter) than those that were in use during the same months of last year. All of these measures are not only desirable, of course, but really necessary if the most efficient broadcasting service is to be provided.

"The increased ionization will make desirable the use for service to certain countries of a frequency or wavelength band not hitherto employed for the purpose—namely, the 28 mcs. (11 meter) broadcasting band. It is more than probable that this band will be suitable for service (of the BBC) to India and the Far East and to South and Central America, as well as continuing to be of service to Africa. It may well be heard in other countries, too, and its use may be found advantageous at some time during the winter for service to North America."

Drop-wire undergoing abrasion tests in birch thicket "laboratory." Below, the new drop-wire, now being installed.

WE'RE GLAD THAT BIRCH TREES SWAY

The telephone wire which runs from the pole in the street to your house is your vital link with the Bell System. More than 17,000,000 such wires are in use.

The wire becomes coated with ice; it is ripped by gales, baked by sun, tugged at by small boys' kite strings. Yet Bell Laboratories research on every material that goes into a drop-wire—metals, rubbers, cottons, chemicals—keeps it strong, cheap, and ready to face all weathers.

Now a new drop-wire has been developed by the Laboratories which lasts even longer and will give even better service. It has met many tests, over 6 or 7 years, in the laboratory and in field experiments. It has been strung through birch thickets—rubbed, winters and summers, against trees, and blown to and fro by winds. In such tests its tough cover lasts twice as long as that of previous wires.

House by house, country-wide, the new wire is going into use. Wire is only one of millions of parts in the Bell System. All are constantly under study by Bell Telephone Laboratories, the largest industrial laboratory in the world, to improve your telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING, INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

(Incidentally, the 21-mc. band is heard well in the Eastern U.S. mornings on several BBC frequencies now in use.)

The BBC is doing a splendid job in giving advance notice to its listeners with regard to the possibilities of increased sunspot activity, with recommendations as to the frequencies expected to be the more advantageous in a particular area during the disturbances.

* * *

Nanking Assignments

According to a supplement to the Bern List, these call letters and frequencies have been assigned for the projected short-wave station at Nanking, China, to be operated by the Central Broadcasting Administration:

XGSA, 6.040; XGSB, 6.080; XGSC, 6.095; XGSD, 6.105; XGSE, 7.200; XGSF, 7.257; XGSG, 9.535; XGSH, 9.605; XGSI, 9.655; XGSJ, 9.675; XGSK, 11.725; XGSL, 11.735; XGSM, 11.800; XGSN, 11.880; XGSO, 15.105; XGSP, 15.135; XGSQ, 15.225; XGSR, 15.235; XGSS, 17.755; XGST, 17.785; XGSU, 17.835; XGSV, 17.845; XGSW, 21.450; XGSX, 21.510; XGSY, 21.550; and XGSZ, 21.620.

Most of these appear to be ex-Japanese frequencies. (Legge)

* * *

Report From India

Those interested in "the other half of the world," will be especially concerned with these comments on reception in India, as just received from Anwer Lalljee, Bombay:

"During August, due to the monsoon, reception conditions were not too good, although the 16- and 13-meter bands were rather good, the latter being 'freakish' at times, in fact. Generally, reception on that band was best from about 6 a.m. to 12 noon, after which it deteriorated and faded out completely around 2 p.m. *Radio Australia* has been heard as early as 10:30 p.m. at R-3 and as late as 4:45 p.m. at R-6 and R-7; similarly, WLWS, Cincinnati, has been coming through regularly from 10 a.m. to 4 p.m. at R-7 to R-8, sometimes better. I have had similar experience with the BBC on this (13-meter) band, it is coming in R-7 to R-8."

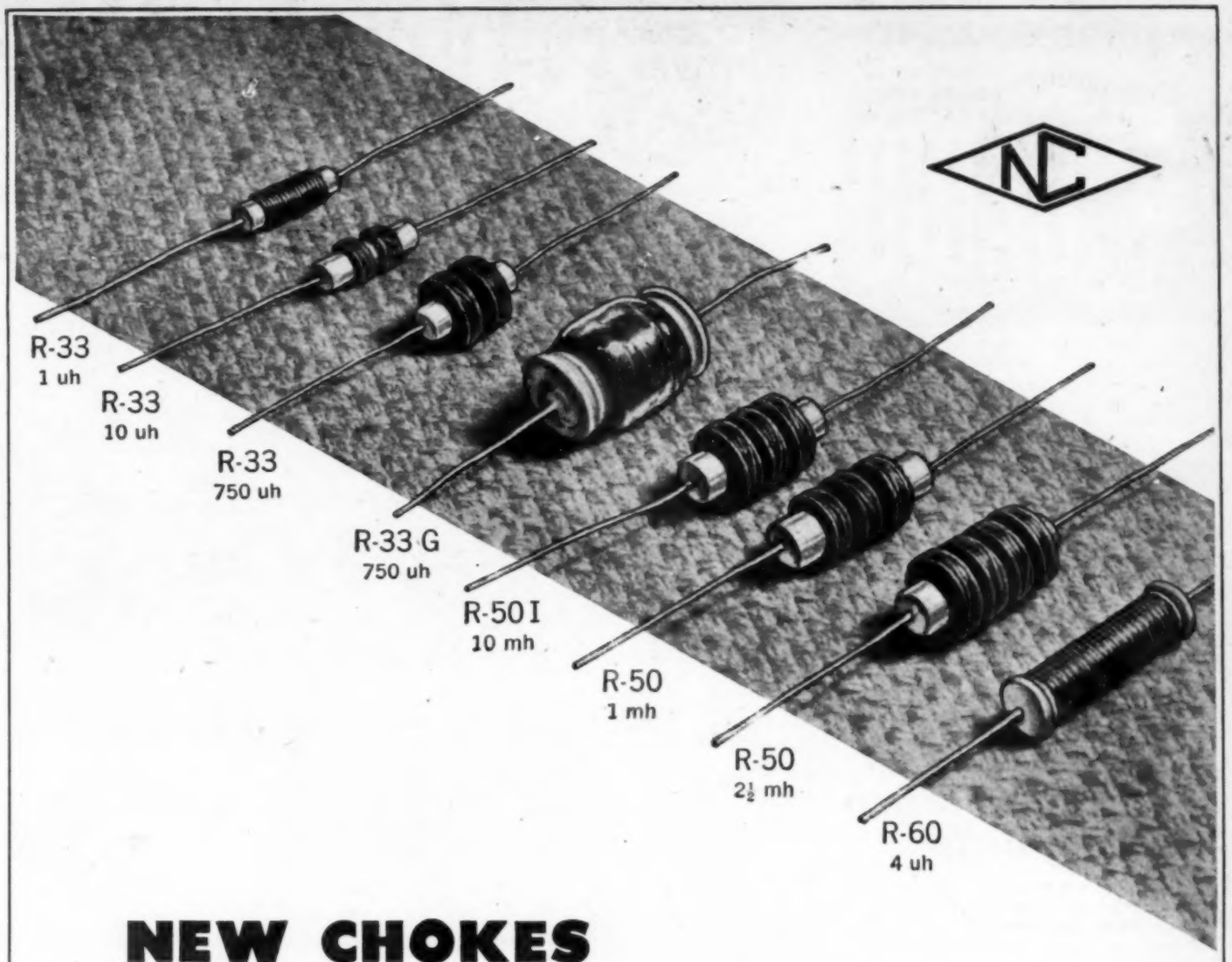
Mr. Lalljee lists as *Best Bets* in his area, Radio SEAC, Colombo, Ceylon; BBC, London (Forces' Program and Eastern Service); Leopoldville, Belgian Congo; KRHO, Honolulu; AIR, Delhi (Home and External Services); CKNC, Montreal; WLWS, Cincinnati; PCJ, Hilversum, Holland; *Radio Brazzaville,* French Equatorial Africa; WGEO, Schenectady; *Radio Australia;* and WNRA, WNBI, New York City.

* * *

RE 41-Meter Band

"The use for broadcasting of frequencies in the 7 megacycles-per-second (41-meter) band has been questioned in letters to the BBC by amateur radio experimenters in North and South America. They imply that, as this band was allotted exclusively to amateurs, broadcasters had no right to use frequencies within it.

(*Continued on page* 124)



NEW CHOKES

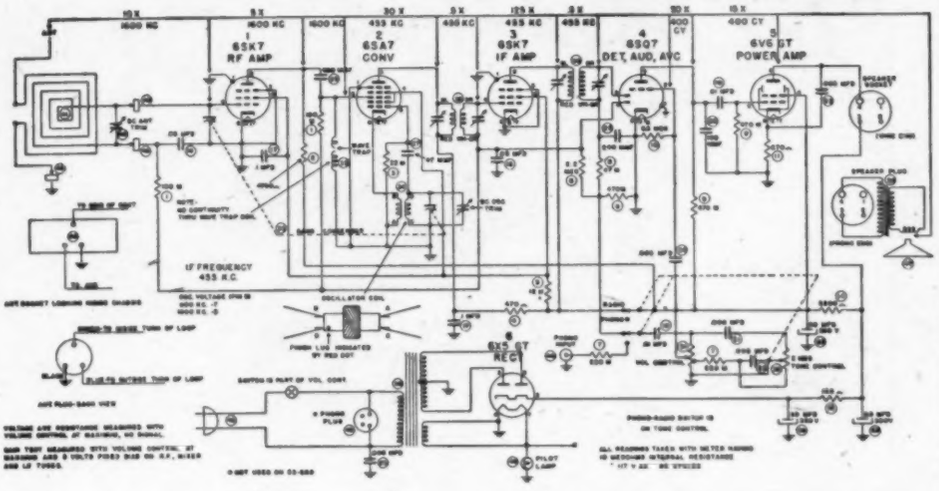
The enlarged line of chokes now offered by National includes many new sizes and types and provides units suited to specialized as well as standard applications. Many popular new chokes are illustrated above, including the R-33G which is hermetically sealed in glass. Other models cover current ratings from 33 to 800 milliamperes in a variety of mountings carefully planned for your convenience. These as well as old favorites like the R-100 are listed in the latest National Catalogue.

NATIONAL COMPANY, INC., MALDEN, MASS.

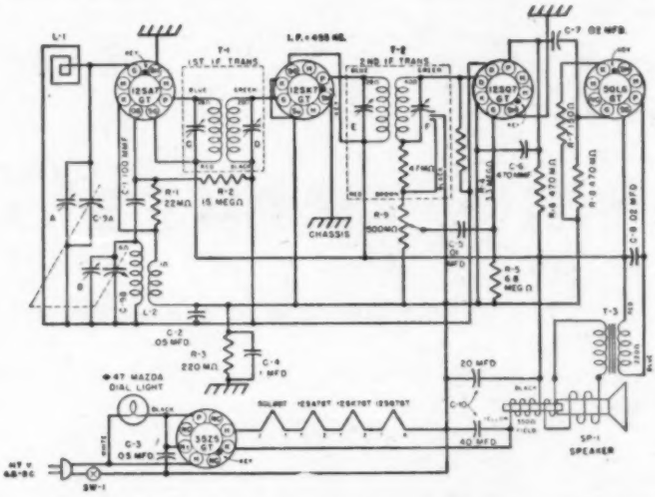
the RN CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 68)

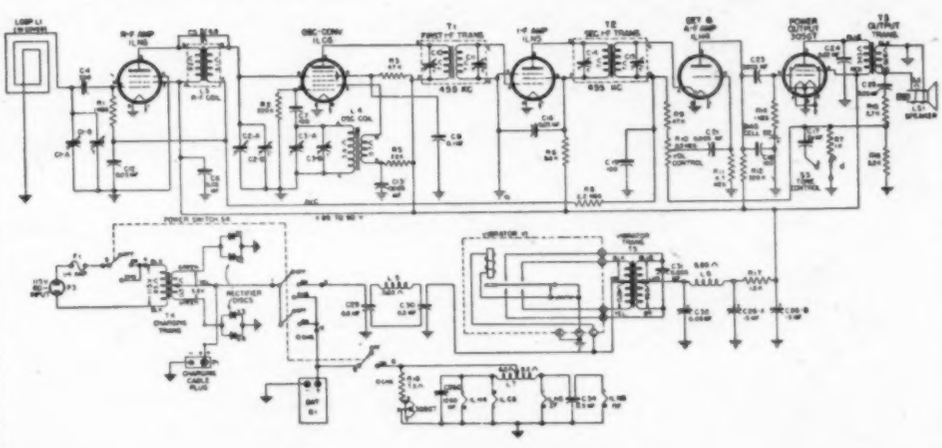
RADIO NEWS, JANUARY, 1947 — **FARNSWORTH MODELS EC-260, EK-262, EK-263, EK-264, EK-265**



RADIO NEWS, JANUARY, 1947 — **DETROLA MODELS 571A, 571B**

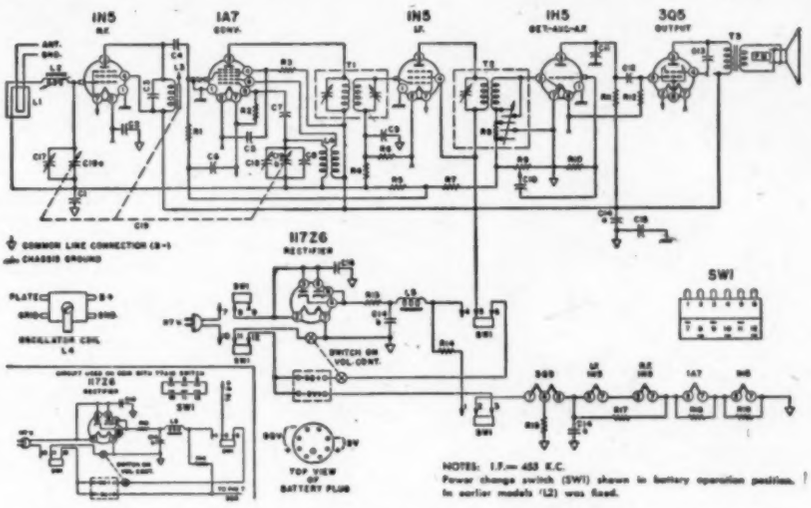


RADIO NEWS, JANUARY, 1947 — **GENERAL ELECTRIC MODEL 250**

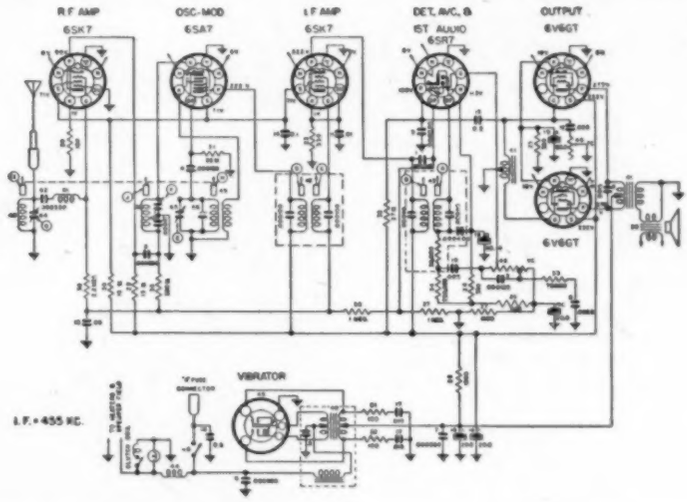


Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

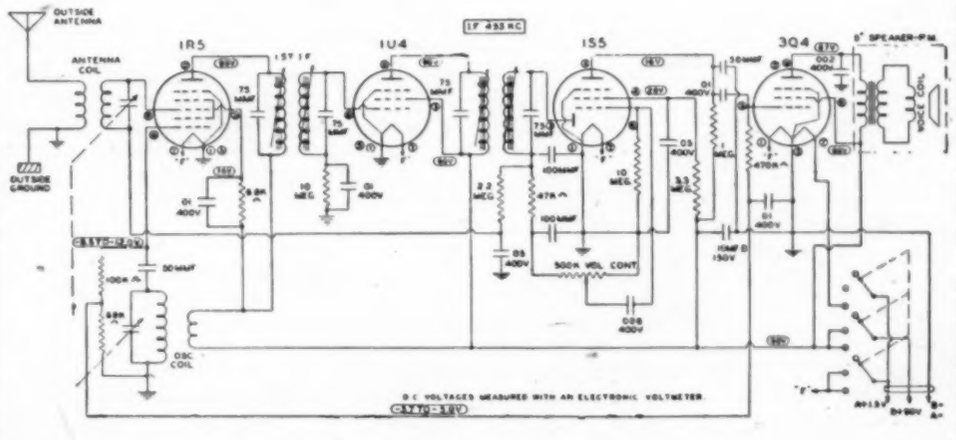
RADIO NEWS, JANUARY, 1947 **ADMIRAL MODELS 6EI, 6EIN**



RADIO NEWS, JANUARY, 1947 **UNITED MODELS 980744, 980745**



RADIO NEWS, JANUARY, 1947 **HOWARD MODEL 920**

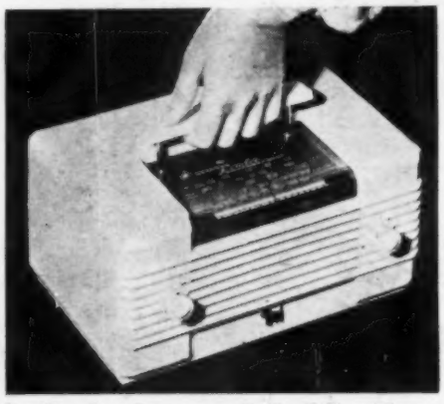


What's New in Radio

PERSONAL RADIO

One of the new features of the 1947 *Remler* "Scotties" is the "invisible" carrying handle which drops down out of sight when the radio is in use.

This new plastic unit, which is made



by *Remler Company Ltd.* of San Francisco, is completely enclosed and dust-proof. The large, easy-to-read dial tunes stations by name. The dial is molded of heavy transparent lucite. The white numerals and colored markers are molded in the underside of the dial and light up against the dark background.

The radio has 5 tubes, including rectifier, and is a.c. operated.

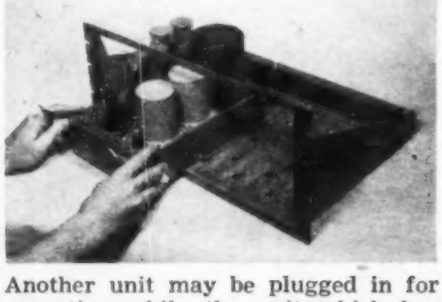
Complete information on the "Scotties" and other radios in the *Remler* line will be furnished by *Remler Company Ltd.*, 2101 Bryant Street, San Francisco 10, California.

PLUG-IN AMPLIFIERS

A line of "plug-in" amplifiers for broadcast field application has been announced by the *RCA* Engineering Products Department of *Radio Corporation of America.*

Revolutionary in design, these amplifiers permit a complete unit to be removed from the rack and another to be installed in its place with no greater effort than that expended in changing an ordinary radio tube.

These new plug-in amplifiers may be removed by pulling a lever near the front of the unit which ejects the unit from its socket and automatically detaches it from the circuit connections.



Another unit may be plugged in for operation while the unit which has been removed may be handled without the danger of blowing a fuse or taking risks with the power supply circuits.

A special shelf assembly for mounting in a standard rack has been developed for use with the plug-in amplifiers.

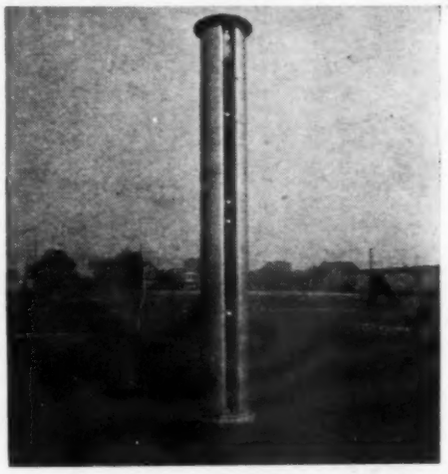
Full information on this piece of broadcast equipment will be furnished by Engineering Products Department of *Radio Corporation of America.* Address your requests to the *RCA Victor Division* at Camden, New Jersey.

"PYLON" FM ANTENNA

RCA Engineering Products Department is responsible for the development and production of a new cylindrical FM antenna which is said to provide higher gain height-for-height than any previous antenna.

Known as the "Pylon" antenna, the new FM radiator is a single-element, mechanically-rigid, self-supporting structure. This antenna requires no additional means of support or mounting, nor are there any arms, loops or circular elements required.

Where high gain is needed for an FM station, additional sections of the antenna can be stacked on top of each other by simply bolting together the end flanges of the pipe-like unit. Since



radiation is compressed in the vertical plane, there is a subsequent power increase. Stacking four sections of the "Pylon" results in a power gain of six.

Full engineering details of this unit will be furnished to broadcast engineers, FM station owners, and those charged with the installation and adjustment of FM antennas. Make your request direct to the Engineering Products Department, *Radio Corporation of America, RCA Victor Division,* Camden, New Jersey.

REPLACEMENT RECTIFIER

Bradley Laboratories, Inc., of New Haven, Conn., has added a replacement rectifier to its line of copper oxide rectifiers.

The unit, designated as "Coprox" Model CX2E4U, offers a multitude of circuit variations, depending on how two or more of its five leads are used.

RADIO TUBES

A REPAIR JOB WELL DONE!

...That's what "OK" means when the tubes you've installed are G-E's

FIRST off, you've pleased your customer by putting General Electric tubes in his set he gave you to repair. For the G-E monogram is more than a familiar symbol to him—it stands for QUALITY.

Second, you've done yourself a good turn, because G-E radio tubes *won't let you down.* The set you've just tagged "OK" will play better than ever, and will keep giving the kind of satisfaction that builds friendship for you and your shop.

When your client is asked to recommend a radio repair source (as happens regularly) he'll give *your* name. That's the sort of helpful person-to-person advertising that makes your business grow, and fattens your profit-account.

So that your radio service always may enjoy top standing in your community . . . replace faulty tubes with high-quality, long-lived G-E's—THE BEST! *Electronics Department, General Electric Company, Schenectady 5, N. Y.*

G.E.'s fact-filled Tube Characteristics Book ETR-15 will help you in your radio service work. Send for your copy. It's free!

GENERAL ELECTRIC

FIRST AND GREATEST NAME IN ELECTRONICS

As a half-wave rectifier it carries a rating of 6 or 12 volts a.c. at 3 ma. d.c. or 12 volts a.c. at 5 ma. d.c. As a double half-wave unit, it is rated at 6 volts a.c. for either 3 or 5 ma. d.c. In its full-wave, back-to-back, applications the unit is rated at 6 or 12 volts a.c. at 5 ma. d.c. and as a full-wave bridge it is rated at 6 volts a.c., 5 ma. d.c.

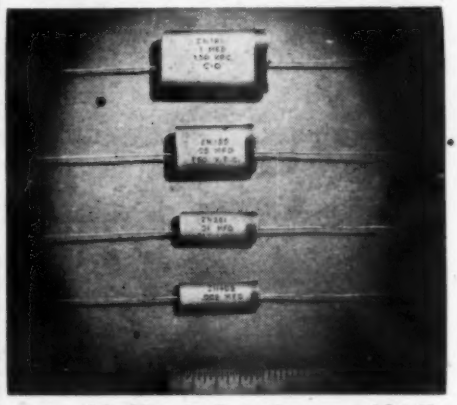
The three-inch flexible leads are color-coded and presoldered to prevent overheating during assembly. Any unused leads are simply clipped off after the circuit has been tested.

A circuit sheet containing complete schematic data is available from *Bradley Laboratories, Inc.*, 82 Meadow Street, New Haven, 10, Conn.

MIDGET CAPACITOR LINE

A complete line of flat midget capacitors, Type ZN, has recently been announced by *Cornell-Dubilier Electric Corporation* for applications in ultra compact electronic devices.

These units are especially designed for hearing aids and pocket radios. Be-



cause this line is flat, they are ideally suited for circuit applications where space is at a premium.

Type ZN midget capacitors are non-inductively wound with Kraft paper and thoroughly impregnated with halowax. The leads are anchored to the capacitor body. Standard ZN types include units from ¾" x ¼" x 3/32" to 1" x ⅝" x 3/16". The values range from .0001 μfd. to .1 μfd., d.c. rated voltages from 150 to 600 volts.

Complete details of the Type ZN line will be furnished by *Cornell-Dubilier Electric Corporation*, South Plainfield, New Jersey.

AMPLIDYNE BOOSTER INVERTER

The operation of radios, movie equipment, public-address systems, fluorescent lighting and improved air conditioning for American railroads has received a new impetus with the announcement by *General Electric Company* of the development of a new amplidyne booster inverter which will provide an ample and economical supply of 60 cycle a.c.

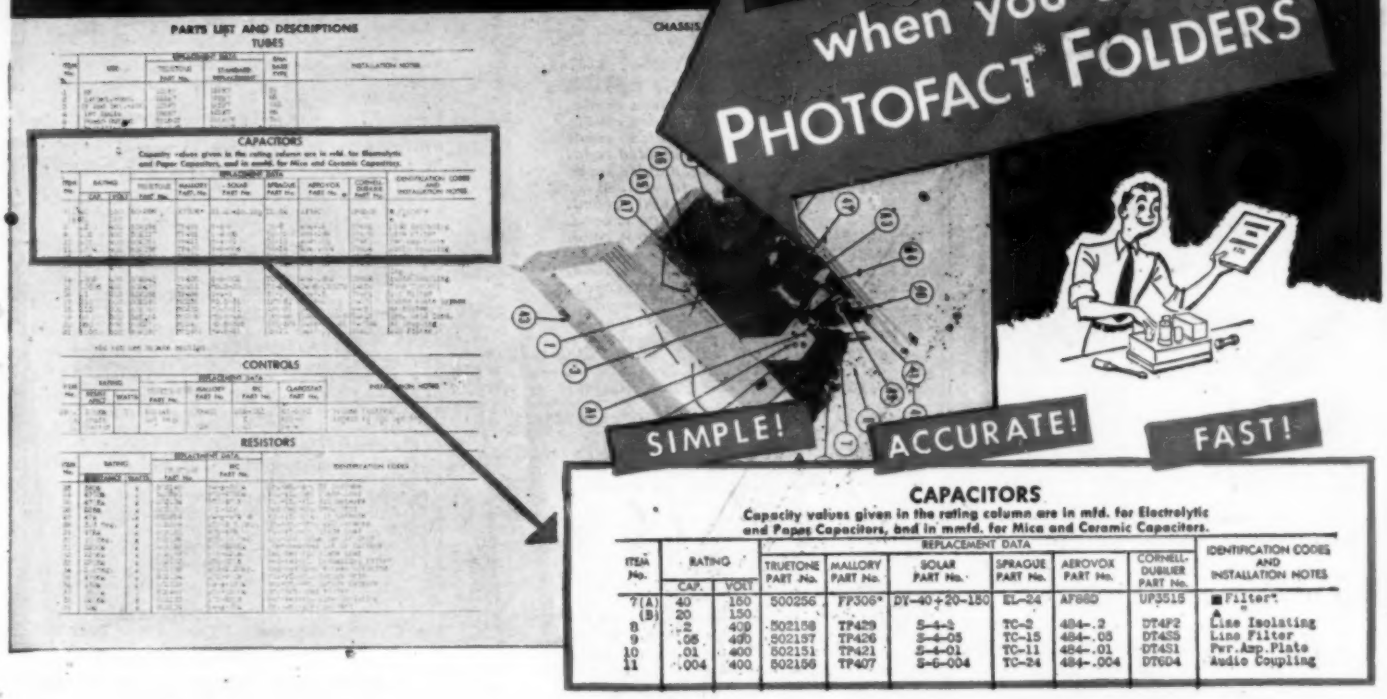
This new equipment changes the current supplied by the railway car's axle-driven generator or battery from d.c. to a.c. and gives constant voltage and frequency without excessive loss.

The amplidyne booster inverter con-

(*Continued on page* 94)

Radio Parts are EASY to identify

when you use PHOTOFACT* FOLDERS



CAPACITORS

Capacity values given in the rating column are in mfd. for Electrolytic and Paper Capacitors, and in mmfd. for Mica and Ceramic Capacitors.

ITEM No.	RATING CAP.	RATING VOLT	REPLACEMENT DATA TRUETONE PART No.	MALLORY PART No.	SOLAR PART No.	SPRAGUE PART No.	AEROVOX PART No.	CORNELL-DUBILIER PART No.	IDENTIFICATION CODES AND INSTALLATION NOTES
7 (A)	40	150	500256	FP306*	DY-40+20-150	EL-24	AF88D	UP3515	■Filter*
(B)	20	150							▲
8	.2	400	502158	TP429	S-4-2	TC-2	484-.2	DT4P2	Line Isolating
9	.05	400	502157	TP426	S-4-05	TC-15	484-.05	DT4S5	Line Filter
10	.01	400	502151	TP421	S-4-01	TC-11	484-.01	DT4S1	Pwr.Amp.Plate
11	.004	400	502156	TP407	S-6-004	TC-24	484-.004	DT604	Audio Coupling

What's your biggest headache when servicing radios? Identifying parts? With PHOTOFACT FOLDERS it's easy to locate and identify any item you want to find. Just look at the Complete Parts List . . . a list that's keyed to clear chassis photographs and a full page, easy-to-read schematic diagram. For instance, the capacitor listing alone gives complete data on capacity, voltage rating, function, replacement types . . . even includes installation notes.

• *No service problem can stump you when you* use PHOTOFACT FOLDERS. They result from the actual examination of the receiver involved, and are not copied from the manufacturer's service data or from looking at his schematics. They tell you everything you need to know about any set manufactured since January 1, 1946—**even to the restringing of dial cords.** They do this by means of pictures, full-page schematics, *original* technical notes that help you work faster, more accurately...easily increase the number of jobs you can do in a week by fifty percent.

PHOTOFACT FOLDERS are sold in sets of 40, each set covering new radios, phonographs, record changers, intercommunication systems, recorders and power amplifiers *within a short time after they reach the market*. Their cost is only $1.50 a set, including membership in the Howard W. Sams Institute. No other radio service compares with PHOTOFACT FOLDERS in completeness, accuracy or timeliness. Use the coupon. *Mail it to your nearest radio parts supply house.*

*Trade Mark Reg.

PUBLICATION DATES:
Set No. 9 . . . . . December 19
Set No. 10 . . . . . December 29

Cut this out and MAIL IT TO YOUR DISTRIBUTOR. If you do not know his name and address, send it directly to Howard W. Sams & Co., Inc., 2924 East Washington Street, Indianapolis 6, Indiana, and we will see that your nearest distributor gets it. In Canada—write to A. C. SIMMONDS & SONS, 301 King Street East, Toronto, Ontario. Canadian Price $1.75.

PLEASE PRINT

☐ Send Set No. 10 ☐ Send Set No. 9
(Circle one or more of following) Send Set No. 8, 7, 6, 5, 4, 3, 2, 1 (at $1.50 a set)

☐ Send me a DeLuxe Binder (at $3.39)

My (check) (money order) (cash) for _____ is enclosed. (If you send cash, be sure to use registered mail)

Name _____

Address _____

City _____ *Zone* ____ *State* ____

Company Name _____

My Distributor's Name _____

City _____

In Each PHOTOFACT FOLDER *You Get—*

1. A cabinet view of the receiver to help you establish identity and control functions. **2.** A top view of chassis and speaker to identify component parts and alignment points. **3.** A bottom view of chassis and/or accessories. **4.** A complete list giving keyed reference to all parts, alignment and schematic diagram. **5.** A complete, full-page schematic diagram. **6.** Stage gain measurements listed on the schematic diagram. **7.** A complete voltage and resistance analysis chart for rapid check of operational values. **8.** Complete alignment instructions on the receiver consistent with the keyed alignment points indicated on photographs. **9.** Dial cord diagram and restringing instructions. **10.** Complete disassembly instructions where required.

HOWARD W. Sams & CO., INC. RADIO PHOTOFACT SERVICE

In Canada—write to A. C. SIMMONDS & SONS, 301 King Street East, Toronto, Ontario

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 62 AND 63)

UNITED MODELS 980744, 980745

Part No.	Code and Description
7233313	1—47 μμfd. molded cond.
1215188	2—56 μμfd. molded cond.
7240577	3—120 μμfd. molded cond.
7230893	4—150 μμfd. molded cond.
7236105	5—220 μμfd. molded cond.
7240566	6, 7—360 μμfd. molded cond.
7236134	8—.0015 μfd., 800 v. cond.
7240578	9—.0025 μfd., 400 v. cond.
7230912	10—.005 μfd., 600 v. cond.
1208600	11—.01 μfd., 600 v. cond.
1211232	12—.025 μfd., 400 v. cond.
7230592	13—.05 μfd., 600 v. cond.
1207908	14—.1 μfd., 400 v. cond.
7240579	15—.2 μfd., 400 v. cond.
7236621	16—.5 μfd., 200 v. cond.
7236075	17—.015/.015 μfd., 1500/1500 v. tub. cond.
7240612	18—20/20 μfd., 400/400 v. elec. cond.
7238553	19—20/20/20 μfd., 25/25/25 v. elec. cond.
1213217	20, 21, 22—100 ohm, ½ w. res.
1213224	23, 24, 25—330 ohm, ½ w. res.
1214543	26—680 ohm, ½ w. res.
1213237	27—1500 ohm, ½ w. res.
1214573	28—1800 ohm, 2 w. res.
7237595	29—15,000 ohm, 1 w. res.
7233653	30—15,000 ohm, 2 w. res.
1214550	31—22,000 ohm, ½ w. res.
1213342	32—27,000 ohm, 1 w. res.
1213844	33—68,000 ohm, ½ w. res.
1214555	34—220,000 ohm, ½ w. res.
1214557	35—330,000 ohm, ½ w. res.
1213282	36, 37—1 megohm, ½ w. res.
1214563	38—2.2 megohm, ½ w. res.
7240519	40—Power trans. assembly
7240464	41—Audio pack driver and output trans. assembly
7238546	42—First i.f. trans. assembly
7240467	43—Second i.f. trans. assembly
7240251	61—Antenna choke coil (part of tuner assembly)
7232957	62—330 μμfd. molded cond. (part of tuner assembly)
7238879	63—470 μμfd. molded cond. (part of turner assembly)
7242984	64—Antenna trimmer (part of tuner assembly
7244037	65—Dual trimmer (part of tuner assembly)
7255725	66—Compensating (part of tuner assembly)

ADMIRAL—MODELS 6EI, 6EIN

Part No.	Code and Description
60B8-104	R_1—100,000 ohm, ½ w. res.
60B8-224	R_2—220,000 ohm, ½ w. res.
60B8-473	R_3—47,000 ohm, ½ w. res.
60B2 475	R_4, R_5, R_6—4.7 megohm, ½ w. res.
60B2-335	R_7—3.3 megohm, ½ w. res.
60B9-503	R_8—50,000 ohm, ½ w. res.
75B1-100	R_9—1 megohm vol. control
60B2-156	R_{10}—15 megohm, ½ w. res.
60B2-105	R_{11}—1 megohm, ½ w. res.
60B2-225	R_{12}—2.2 megohm, ½ w. res.
61A2-2	R_{13}—22 ohm, wire-wound, ½ w. res.
61A3-5	R_{14}—2450 ohm, wire-wound, 5 w. res.
60B8-152	R_{15}—1500 ohm, ½ w. res.
60B8-561	R_{17}—560 ohm, ½ w. res.
60B8-221	R_{18}—220 ohm, ½ w. res.
60B8-121	R_{19}—120 ohm, ½ w. res.
64B1-32	C_1—.05 μfd., 200 v. cond.
64B1-28	C_2—.25 μfd., 200 v. cond.
65B1-9	C_3—.00042 μfd. mica cond.
65B5-22	C_4, C_{11}—.00025 μfd. mica cond.
64B1-25	C_5, C_6, C_9, C_{10}, C_{12}—.01 μfd., 400 v. cond.
65B5-11	C_7—.00005 μfd. mica cond.
65B5-3	C_8—.000015 μfd. mica cond.
64B1-9	C_{13}—.002 μfd., 600 v. cond.
67C7-42	C_{14a}, C_{14b}, C_{14c}—50/30/100 μfd., 150/150/25 v. elec. cond.
64A2-1	C_{15}—.2 μfd., 400 v. cond.
64B1-22	C_{16}—.05 μfd., 400 v. cond.
66A12-5	C_{17}—Antenna trimmer
	C_{18}—Osc. Trimmer (part of gang)
68B4	C_{19}—Condenser gang
72B9-2	T_1—First i.f. trans.
72B10-2	T_2—Second i.f. trans.
	T_3—Output trans.

GENERAL ELECTRIC—MODEL 250

Part No.	Code and Description
URD-212	R_1, R_{14}—1 megohm, ½ w. res.
URD-105	R_2, R_{12}—220,000 ohm, ½ w. res.
URD-089	R_3, R_9—47,000 ohm, ½ w. res.
URD-081	R_5—22,000 ohm, ½ w. res.
URD-067	R_6—3600 ohm, ½ w. res.
URD-049	R_7—1000 ohm, ½ w. res.
URD-129	R_8—2.2 megohm, ½ w. res.
RRC-008	R_{10}—.5 megohm vol. control
URD-137	R_{11}—4.7 megohm, ½ w. res.
URD-059	R_{15}—2700 ohm, ½ w. res.
URD-057	R_{16}—2200 ohm, ½ w. res.
URE-053	R_{17}—1500 ohm, 1 w. res.
RRG-001	R_{18}—7.5 ohm, ½ w. res.
RCT-008	C_{1A}, C_{1B}, C_{2A}, C_{2B}, C_{3A}, C_{3B}—Tuning cond. and trimmers
UCU-040	C_4—330 μμfd. mica cond.
UCN-506	C_5—6.8 μμfd. ceramic cond.
RCC-028	C_6, C_{12}, C_{18}, C_{25}, C_{32}—.05 μfd., 400 v. cond.
UCU-028	C_7, C_{19}, C_{19}—100 μμfd. mica cond.
UCC-030	C_8, C_{17}—.1 μfd., 400 v. cond.
UCC-039	C_{13}, C_{21}, C_{23}—.005 μfd., 600 v. cond.
UCC-041	C_{24}—.02 μfd., 600 v. cond.
RCE-007	C_{26A}, C_{26B}, C_{26C}—15/15/1200 μfd., 150/150/1.5 v. elec. cond.
RCC-070	C_{29}, C_{30}—.5 μfd., 120 v. cond.
RCC-073	C_{31}—.003 μfd., 1500 v. cond.
RCC-069	C_{34}—.5 μfd., 120 v. cond.
RLL-008	L_1—Loop antenna assembly
RLB-002	L_3—R.f. coil
RLC-008	L_4—Osc. coil
RLF-001	L_5, L_6—Vibrator and B+ choke
RLF-002	L_7—Fil. choke
RTL-001	T_1—First i.f. trans.
RTL-012	T_2—Second i.f. trans.
RTO-007	T_3—Output trans.
RTC-001	T_4—Rectifier trans.
RTV-001	T_5—Vibrator trans.

HOWARD—MODEL 920

See Circuit Diagram for Component Part Values

FARNSWORTH—MODELS EC-260, EK-262, EK-263, EK-264, EK-265

Part No.	Code and Description
77214	1—100,000 ohm, ½ w. res.
77211	2—4700 ohm, ½ w. res.
77266	3—22,000 ohm, ½ w. res.
77261	4—470 ohm, ½ w. res.
77155	5—12,000 ohm, 2 w. res.
77270	6—2.2 megohm, ½ w. res.
77216	7—220,000 ohm, ½ w. res.
77213	8—47,000 ohm, ½ w. res.
77217	9—470,000 ohm, ½ w. res.
77273	10—6.8 megohm, ½ w. res.
77174	11—270 ohm, 1 w. res.
77258	12—100 ohm, ½ w. res.
77301	14—2200 ohm, 2 w. res.
25196	16—.05 μfd., 600 v. cond.
25215	17—.1 μfd., 600 v. cond.
25194	18—.01 μfd., 600 v. cond.
25183	20—.005 μfd., 600 v. cond.
25185	21—.002 μfd., 600 v. cond.
25184	22—.003 μfd., 600 v. cond.
25031	23—.005 μfd., 600 v. line buffer
25188	25—100 μμfd. mica cond.
25187	26—240 μμfd. mica cond.
25193	27—47 μμfd. mica cond.
25180	28—30/20/20 μfd., 350/300/250 v. elect. cond.
15136	30—Gang cond. and drive drum
78071	31—Vol. control
90148	32—Tone control and phono sw.
38484	33—Wave trap
38483	34—Osc. coil
38536	35—First i.f. trans.
38537	36—Second i.f. trans.
94025	39—Power trans.
94197	39—Output trans. (EC-260, EK-265)
94198	39—Output trans. (EK-262)
94199	39—Output trans. (EK-263, EK-264)
26032	40—Antenna trimmer

DETROLA—MODELS 571A, 571B

Part No.	Code and Description
BR17B223	R_1—22,000 ohm, 1/3 w. res.
BR17B156	R_2—15 megohm, 1/3 w. res.
BR17B224	R_3—220,000 ohm, 1/3 w. res.
BR17B335	R_4—3.3 megohm, 1/3 w. res.
BR17B685	R_5—6.8 megohm, 1/3 w. res.
BR17B474	R_6, R_8—470,000 ohm, 1/3 w. res.
BR16C151	R_7—150 ohm, ½ w.res.
B-9051-1	R_9—500,000 ohm, vol. control & sw.
BM78A101	C_1—100 μμfd. mica cond.
BD210503	C_2—.05 μfd., 200 v. cond.
BC31B503	C_3—.05 μfd. molded cond.
BD410104	C_4—.1 μfd., 400 v. cond.
BD410103	C_5—.01 μfd., 400 v. cond.
BM78A471	C_6—470 μμfd. mica cond.
BD410203	C_7, C_8—.02 μfd., 400 v. cond.
C-51155-1	C_9—2-section var. cond.
A-8948	C_{10}—40/20 μfd., 150/150 v. elec. cond.
B-51243	L_1—Loop antenna
B-51159	L_2—Osc. coil assembly
B-51010	T_1—First i.f. trans.
B-51011	T_2—Second i.f. trans.

—30—

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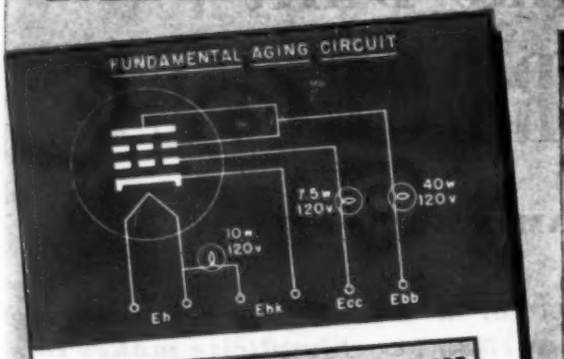

AGING SCHEDULE FOR HYTRON 50L6GT

Step	Minutes	Eh a-c	Ehk a-c	Ecc d-c	Ebb d-c
1	5	50	110	0	0
2	3	70	110	0	0
3	5	80	110	0	0
4	3	80	110	0	0
5	5	70	0	120	120
6	4	0	0	0	0
7	5	50	0	-10	120

Electrode potentials are varied as shown in the schedule. Actual voltages at the socket depend on currents drawn through the incandescent lamps used as economical, interchangeable current-limiting resistors.

Operations performed in seven steps are: (1) discovery of heater-cathode shorts (2) beginning of cathode processing to stabilize emission (3) further seasoning and burning off of h-k leakage (4) h-k potential increased to eliminate leakage (5) grid, screen, and plate potentials applied to complete de-gassification (6) cooling off period (7) normal potentials applied to pre-heat for test.

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Yes, radio tubes also must be "aged in the wood." Aging activates the cathode under accelerated life conditions, just before test. In the fundamental aging circuit shown, final seasoning and de-gassification stabilize characteristics in accordance with the carefully planned aging schedule.

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Other features of the aging wheel are elimination of needless handling, fast and steady pacing of the work, easy servicing, and readily interchangeable load lamps.

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Home Built TRF RECEIVER

By JAMES W. HOSKINS*

Construction details for a 4-tube receiver covering the range from 545 to 1580 kc. Simplicity makes this unit suitable for the beginner or radio experimenter.

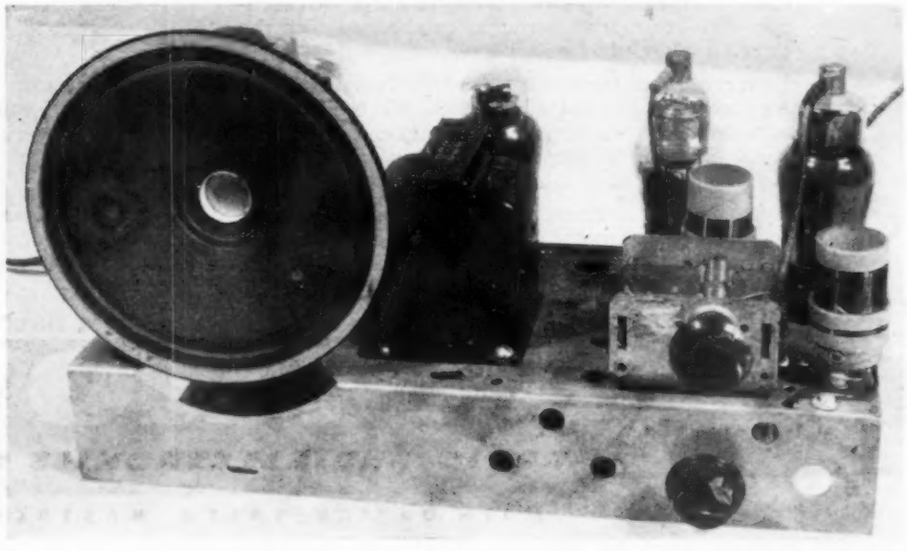
THIS radio receiver has been designed and tested so that a simplified model may be constructed by anyone who carefully studies the drawing and pictures. The circuit is so designed that it eliminates the usual "bugs" encountered in so-called simple receivers. It is also designed to be used in making various tests and measurements for a practical course in radio servicing. This is accomplished by building the receiver and getting it to work and then substituting defective parts and making the necessary measurements to determine what effect the defective part or parts have on the receiver. The circuit as shown in the diagram of Fig. 1 uses a 6D6 tube as a screen grid r.f. amplifier. A 6C6 tube is used as an infinite impedance detector, since this type of detector actually adds considerable amplification to the signal as well as performing its regular duty of rectifying the r.f. voltage. A 42 tube as a power amplifier further amplifies the audio signal so as to have enough power to drive a speaker. An 80 tube, which rectifies high voltage a.c., supplies the "B" voltage for the receiver.

The parts for the receiver may be all new parts, if available, or may be salvaged from old receivers. If a power supply is available the power transformer and the 80 tube may be eliminated from the receiver. To connect the power supply to the receiver connect "B" plus to the filament of the 80, and "B" minus to the center tap of the high-voltage winding. The filament voltage is connected to the chassis of the receiver and to the other side of the filament winding of the transformer. These connections refer to the diagram but in the discussion dealing with the construction of the receiver the power transformer will be omitted.

In the construction of the receiver it is necessary to assemble the parts that are mounted on the chassis first. If a blank chassis is used it will be necessary to drill it for the various parts such as tube sockets, etc. Any salvaged parts which are used should be tested to make sure that they are in working order before installation is made. The filament circuit and the other a.c. circuits should be wired first so as to get the leads on the bottom of the chassis to prevent the other parts from picking up 60-cycle hum. It is necessary to keep all the grid leads as

* Reprinted in part from Sept., 1944, issue of *Industrial Arts and Vocational Education.*

Front-top view of chassis assembly showing correct placement of parts.



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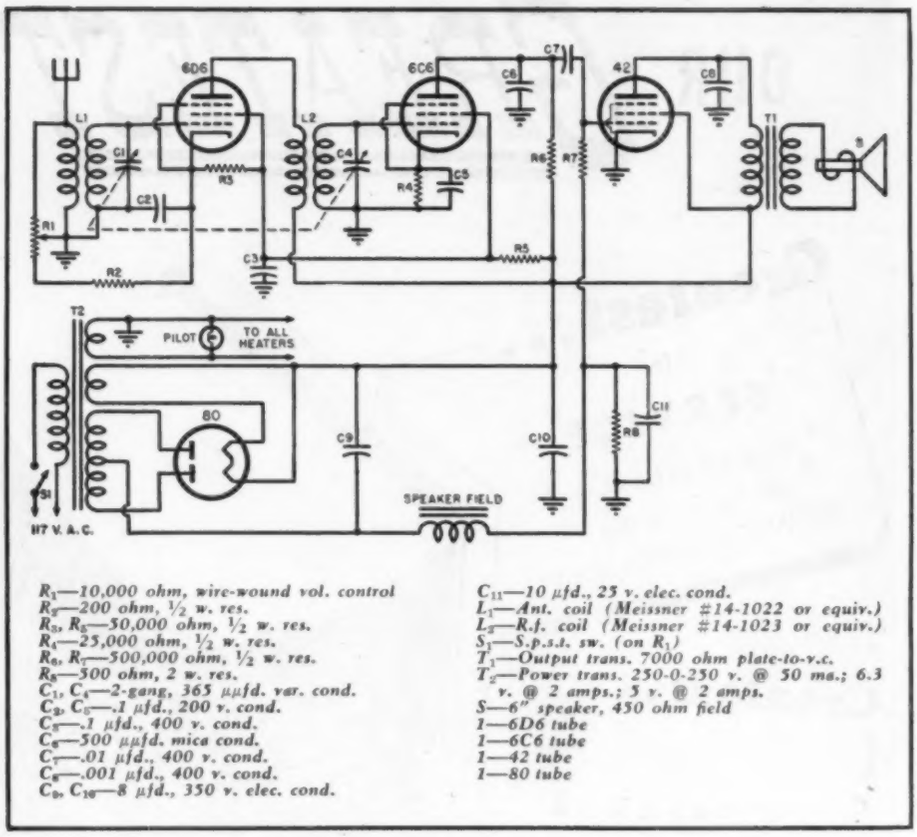


R_1—10,000 ohm, wire-wound vol. control
R_2—200 ohm, ½ w. res.
R_3, R_5—50,000 ohm, ½ w. res.
R_4—25,000 ohm, ½ w. res.
R_6, R_7—500,000 ohm, ½ w. res.
R_8—500 ohm, 2 w. res.
C_1, C_4—2-gang, 365 μμfd. var. cond.
C_2, C_3—.1 μfd., 200 v. cond.
C_5—.1 μfd., 400 v. cond.
C_6—500 μμfd. mica cond.
C_7—.01 μfd., 400 v. cond.
C_8—.001 μfd., 400 v. cond.
C_9, C_{10}—8 μfd., 350 v. elec. cond.
C_{11}—10 μfd., 25 v. elec. cond.
L_1—Ant. coil (Meissner #14-1022 or equiv.)
L_2—R.f. coil (Meissner #14-1023 or equiv.)
S_1—S.p.s.t. sw. (on R_1)
T_1—Output trans. 7000 ohm plate-to-v.c.
T_2—Power trans. 250-0-250 v. @ 50 ma.; 6.3 v. @ 2 amps.; 5 v. @ 2 amps.
S—6" speaker, 450 ohm field
1—6D6 tube
1—6C6 tube
1—42 tube
1—80 tube

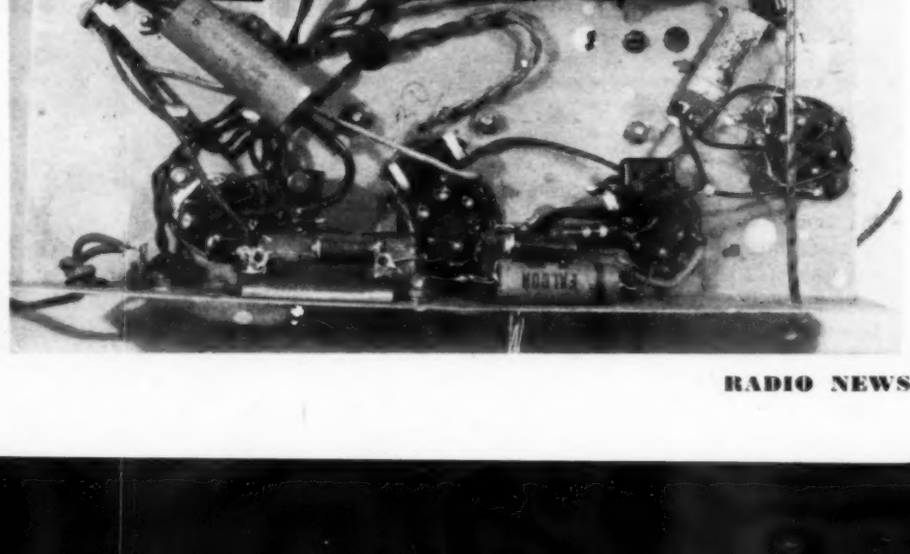
Fig. 1. Schematic diagram of the a.c. operated TRF receiver.

short as possible to keep the set from going into oscillation and from picking up hum from the a.c. leads. When wiring the filter condensers be sure to watch the polarity of these condensers; they will be marked on the case of the condenser or in most condensers the red lead wil be positive and the black lead negative. If this condenser is salvaged from an old receiver be sure to notice which terminals are connected to the positive and negative leads in the old receiver.

Upon completing the wiring of the receiver, carefully check it with the diagram as this will save many hours of work later and will preclude burning out parts because of incorrect connections. When the receiver is completely wired and checked, connect it to an a.c. line and a good outside antenna. One should be able to tune in several of the stronger stations. To get the receiver to operate properly one adjustment is necessary; tune in a station around 1400 kc. (the tuning condenser will be almost wide open); turn the volume down so the station can just be heard and adjust the two trimmer condensers on the variable condenser for maximum volume. If this receiver is connected to a good outside antenna reception of fairly distant stations may be expected occasionally.

—30—

Under chassis view of the 4-tube receiver showing simplicity of wiring.



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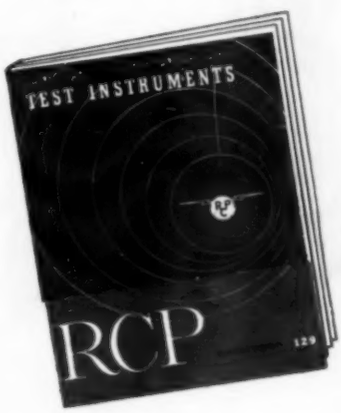

Ranges

A-C VACUUM-TUBE VOLTMETER: — (Direct reading) Input capacity of 0.00005 mfd at terminals of instrument. Input resistance of 160 megohms on 1,500 and 6,000 volts and 16 megohms on low ranges.—Seven ranges: 0/3/6/30/150/600/1,500/6,000 volts.

D-C VACUUM-TUBE VOLTMETER: — (Direct reading) Sensitivity of 160 megohms on 1,500 and 6000 volts and 16 megohms on low ranges.—Six ranges: 0/6/30/150/600/1,500/6,000 volts.

VACUUM-TUBE OHMMETER: — (Direct reading) from 0.1 ohm to 1,000 megohms. Seven ranges: 0/1,000/10,000/100,000 ohms; 0/1/10/100/1,000 megohms.

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RC Oscillator

(*Continued from page 47*)

paralleling two sections, it is possible to vary the range in excess of ten to one (150 to 1500 cycles).

By addition of three separate sets of R_1 and R_2 resistors and switching, three ranges are created: 15 to 150 cycles; 150 to 1500 cycles; 1500 to 15,000 cycles. When such ranges of frequencies are covered, phase shift becomes important. If phase shift is eliminated, a calibration for one set of resistors will remain constant on the other ranges if the resistors are identical in pairs and vary in a ratio of ten to one, such as 100,000 ohms, 1 megohm and 10 megohms, providing the resistors have close tolerances. A 1% resistance error will create the same percentage of frequency error.

If phase shift occurs, the calibration for each set of resistors will not be linear. This condition is indicated by the fact that the ranges follow the calibration for a portion of the dial and become in error toward the high frequency end of the calibration. Too low a value of capacity used in either C_1 or C_2 will create phase shift at low frequencies. Circuit wiring and the use of parts that have capacity to ground will cause the high frequency calibration to vary.

The oscillator voltage can be obtained from two points, the cathode of the 6G6 or the plate of the 6G6. Approximately 1 volt is available at the cathode and 30 volts at the plate. Output taken from the plate circuit must be fed into a high impedance load which will not upset the electrical constants of the circuit thus causing frequency variation and instability.

The *RC* oscillator is extremely stable, since the frequency is determined by the *RC* network. Variable condensers have a very slight capacity change due to temperature variations, which in most applications can be disregarded. Carbon resistors are perfectly satisfactory for normal temperature changes but cause a frequency variation of approximately 10% when the temperature is varied from +70 to −55 degrees Centigrade. Metalized resistors are readily available and vary approximately 2% over the temperature cycle mentioned above. The use of metalized resistors is desirable. The variation of the other resistor values due to temperature causes little or no effect with the exception of R_2.

Construction Considerations

Fig. 2 is a circuit diagram of an *RC* oscillator with isolation stages and a built-in vacuum tube voltmeter. This unit is quite similar to an *RC* oscillator now manufactured commercially. Before constructing an *RC* oscillator, the use of the oscillator should be considered. If the oscillator application only requires fixed frequency operation, the addition of the two isolation stages may not be required.

Building in a vacuum tube voltmeter may be of no particular advantage. In that case the oscillator would only require three tubes, one being the rectifier. Such units can be constructed in an extremely short length of time with a minimum of parts and expense. Many such oscillators were constructed and used twenty-four hours a day in production. Such oscillators have been known to operate at 400 cycles for weeks with a frequency variation of only a few cycles. If the oscillator is to be used as a general purpose piece of equipment, it becomes desirable to add the isolation stages. The addition of a built-in vacuum tube voltmeter is desirable when the equipment is used for making fidelity measurements. The vacuum tube voltmeter circuit in Fig. 2 is extremely simple, consisting of few parts, and will alleviate the necessity of borrowing a voltmeter from some other test position each time a fidelity run is made.

To help the reader determine how much of the equipment he needs to build to meet his particular requirements, an outline is given of the equipment necessary to make certain tests.

1. *Frequency Measurements*—An oscillator with an accurate calibration and an oscilloscope or headphones. If extremely accurate measurements are required, the oscillator should be checked against a secondary standard

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to correct any errors that might exist. By feeding the unknown frequency into the vertical plates of the scope and the audio oscillator into the horizontal plates, it is possible to use a circle pattern to indicate exact resonance. This gives a much higher degree of accuracy than headphones in that the frequency response of headphones is extremely poor for very low frequencies. If the oscillator is to be used primarily for this type of measurement, the addition of the isolation stages and vacuum tube voltmeter would be just so much excess equipment.

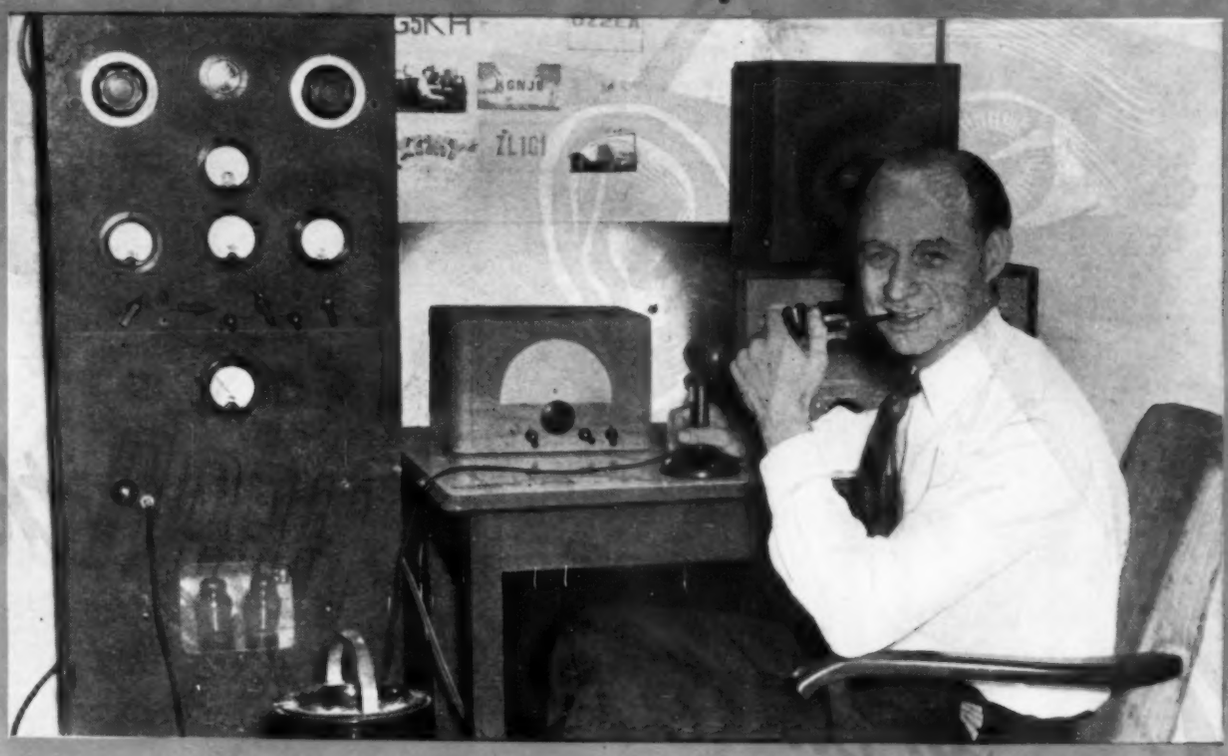
2. *Fixed Frequency Voltage Generators*—In many applications for test equipment, such as a production line, it becomes desirable to have a fixed frequency source of voltage that has a stable and constant output. Such voltages are fed through transmission lines throughout the production area and become available at convenient terminal boxes. The construction of the oscillator for this particular type of application can simply consist of a small power supply and a 2 tube *RC* oscillator without the variable condenser, making a very compact unit. Selection of the *RC* network values will produce the frequency desired, and the equipment will require little or no attention. Where several frequencies are required simultaneously, separate oscillators can be constructed. If several fixed frequencies are required, but operation of only one frequency at a time ,the addition of a switch and various combinations of *RC* network will produce the desired results.

3. *Fidelity Measurements* — Equipment necessary consists of a variable frequency oscillator, level indicator and standard output meter. For this particular application it becomes desirable to build a piece of equipment such as Fig. 2 in its entirety.

4. *Distortion Measurements*—This type of measurement requires an audio oscillator free from distortion (less than 1%), a standard output load or meter and a wave analyzer or distortion meter. For this application the vacuum tube voltmeter built into the equipment is not necessary, but the use of the isolation stages is desirable, since it may be necessary to feed an input circuit of a low or high impedance. The isolation stage alleviates the possibility of some reflection back into the oscillator which might cause an error in measurement.

Construction

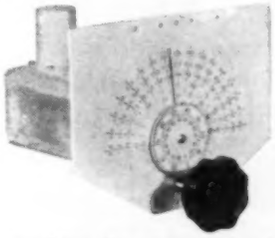
The layout for this piece of equipment is quite conventional, with the power supply to the rear and side, variable condenser in the center and the oscillator, isolation tubes and vacuum tube voltmeter tube on the other side. The location of all parts above the chassis should be at least 1" clear of the variable condenser. The variable condenser must be shielded, and this 1" of space allows the shield to be sufficiently large so that capacity be-



The Collins 70E-8 wins an Enthusiastic Booster!

Frank W. Oberlander, W9YPS

When W9YPS got his 70E-8 PTO (permeability tuned oscillator), we asked him to give it a workout and send us his comments. He did, and we'd like to quote him:



Frank's exciter line-up, following the 70E-8, consists of a 6AK6 isolator (untuned), 6AG7 buffer-doubler, 7C5 buffer-doubler. Here are some of the reasons why he's happy with his PTO:

1. The 70E-8 is accurate to within ½ kc on 80 meters.
2. It's calibrated directly in frequency.
3. The frequency range of 1600-2000 kc is covered in sixteen turns of the vernier dial.
4. The stability is within 1 dial division.
5. The dial covers the 80, 40, 20, 15, 11, and 10 meter bands.

Write for an illustrated bulletin with full details.

Galesburg, Illinois
October 1, 1946

Collins Radio Co.
Cedar Rapids, Ia.

Gentlemen:

I wish to express my appreciation of the new 70E-8 PTO. I have used this unit since the latter part of July on 75 meter phone, 80 meter cw, 20 meter phone and cw and 10 meter phone and cw. I cannot fully describe the feeling of assurance that this unit affords in the matter of stability and ease of frequency spotting. I am sure it has enabled me to make many contacts that otherwise I would not have made. All reports are very favorable as to stability and freedom from chirps. All contacts on cw were greeted with T9X reports.

It certainly is one of the finest pieces of equipment that I possess and I would truly feel lost if I had to be without one.

Yours very truly,
Frank W. Oberlander (W9YPS)
457 Fifer Street
Galesburg, Illinois

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signal with the new CA-12

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The latest of a long line of Signal Tracers designed by *SUPERIOR*.The new Model CA-12 permits you to SEE and HEAR the signal reducing the time required to locate the source of trouble in radio receivers to a new minimum. Quantitative and Qualitative analysis of the signal is made amazingly easy with the aid of this new versatile tool. As the detector probe is moved to follow the signal from antenna to speaker, the *SIGNAL INTENSITY* can be read directly on the meter. Then a flip of the switch permits you to hear the *QUALITY* of the signal in the Alnico V Speaker. Since the introduction of signal tracing in 1939 we have worked continuously developing and improving this simplified "short cut" method of radio servicing. This new model provides all the services of previous models plus many additional advantages, yet operating time has been reduced to an absolute minimum. Always ready for instant use it takes *less than five seconds* to begin using this versatile unit. No maze of special cables—the Model CA-12 uses only one connecting cable. No line cord the CA-12 operates on self-contained batteries and no tuning controls of any kind are used in the model. To operate it is necessary only to throw the switch and immediately use the Detector Probe to follow the signal from antenna to speaker, with relative signal intensity readings available on the scale of the meter. The meter is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

Manufactured by **SUPERIOR INSTRUMENTS COMPANY**

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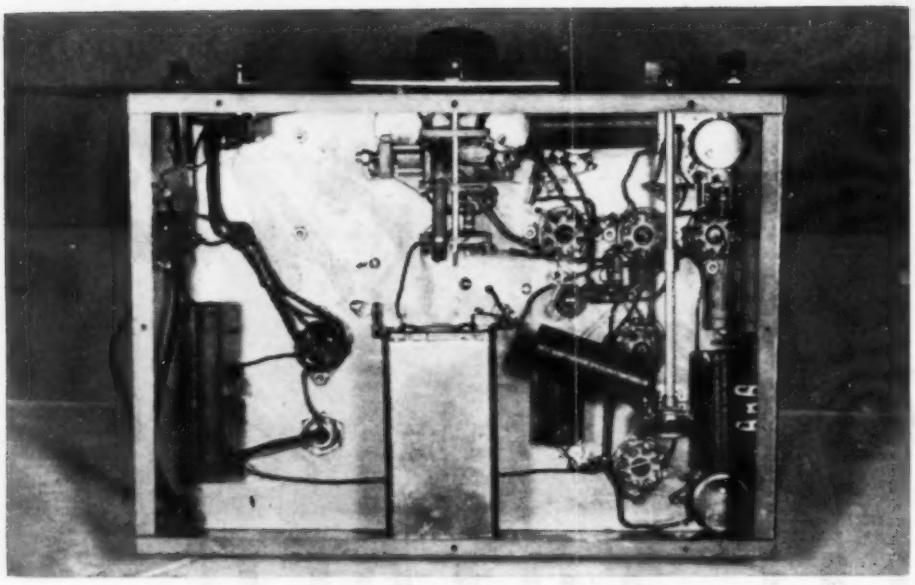
FEATURES:

★ COMPARATIVE *INTENSITY* OF THE SIGNAL IS READ DIRECTLY ON THE METER—*QUALITY* OF THE SIGNAL IS HEARD IN THE SPEAKER.
★ SIMPLE TO OPERATE—ONLY ONE CONNECTING CABLE—NO TUNING CONTROLS.
★ HIGHLY SENSITIVE—USES AN IMPROVED VACUUM-TUBE VOLTMETER CIRCUIT.
★ TUBE AND RESISTOR CAPACITY NETWORK ARE BUILT INTO THE DETECTOR PROBE.
★ BUILT-IN HIGH GAIN AMPLIFIER—ALNICO V SPEAKER.
★ COMPLETELY PORTABLE—WEIGHS 8 POUNDS—MEASURES 5½" x 6½" x 9".



Under chassis view of Wien Bridge audio oscillator.

tween the shield and the variable is kept at a minimum.

Capacity caused by the shield will reduce the high frequency range of the oscillator. Three variable resistors are located in the immediate vicinity of the range switch and are in series with the *RC* network resistors. The network resistors were checked on an ohmmeter, and due to production tolerances, the lowest value of resistance was placed in series with the variable resistor to ground. This made it possible to match both resistor networks. These resistors also give a small amount of frequency variation which allows the operator to make corrections in the calibration so that one calibration will hold for all three ranges.

The coupling condenser between the 6SJ7 and the 6G6 was mounted above the chassis to reduce capacity of the condenser to ground. The gain control was located at a point where lead length could be kept at a minimum. Locating the gain control on the panel would have eliminated the use of an extension shaft but would have, in turn, required the use of shielded leads to and from the control.

Shielded leads will cause a high frequency attenuation which results in reduced output at high frequencies. Note the addition of a 50 $\mu\mu$fd. variable condenser shunted across the top section of the variable condenser. This capacitor is adjusted to compensate for the capacity of the frame of the variable to ground.

The operation of the isolation stages is as follows: The first 6J5 operates as a cathode follower. The coupling to the second 6J5 is accomplished by the common cathode resistor of the two 6J5s. The plate circuit of the second 6J5 is conventional. This type of amplifier lends itself admirably to this particular application in that it is practically distortionless up to 15 volts output, and at 25 volts the distortion is less than 2%. Since distortion measurements normally require low level, the amplifier proves quite adequate. The construction of distortionless amplifiers of conventional type requires considerably more parts, adding expense to the unit. The vacuum tube voltmeter consists of one-half of a 6SL7 being used as a diode and the other half as a vacuum tube voltmeter. The power supply is quite conventional. The use of a metal plate

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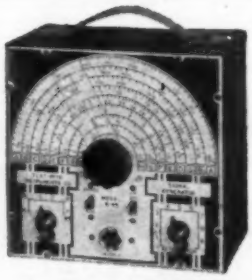

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"Speedy Operation" assured by newly designed rotary selector switch which replaces the usual snap toggle or lever action switches.
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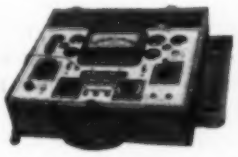

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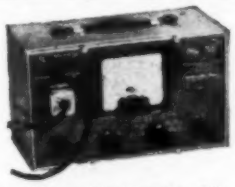

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over the bottom of the chassis is desirable but not absolutely necessary. Stray fields entering the bottom of the chassis will give an indication of distortion in excess of 1%. All parts values can be of 10% tolerance other than the *RC* network and the negative feedback resistor.

The selection of parts and tube types was dictated by the availability of such material at the time. This accounts for the unusual tube type selection. It is recommended that the 6SJ7 and the 6G6 be used in the oscillator, but the two 6J5s may be replaced by one 6SN7. The 6SL7 can be replaced by a 6H6 and a 6SQ7. The 80 type rectifier tube can be replaced by a 5Y3 or equivalent. The choice of power transformer was dictated by procurement rather than by design. Since the power supply voltage was too high, it became necessary to add a voltage divider. The current drain of the equipment is approximately 30 mils, so a low voltage transformer can be used by simply adjusting the output voltage between 180 and 200 volts.

Tuning Procedure

Adjust the correcting resistors in the *RC* network so the range switch decades. With the range switch in No. 1 position and the variable condenser closed, the frequency should be 15 cycles. Rotate the range switch to No. 2 position. Adjust for 150 cycles. With the range switch in No. 3 position, adjust for 1500 cycles. Of course, such adjustment will not be possible if the *RC* network resistors do not increase in steps of 10.

In this case it becomes necessary to calibrate the dial for all three ranges, or add or subtract resistance values until the calibration does decade. The negative feedback resistor may require adjustment. This adjustment is made by substituting a 10,000 ohm potentiometer and finding the correct value as outlined. Connect an a.c. vacuum tube voltmeter to the output jacks and adjust output for approximately 5 volts. Now rotate variable condenser from minimum to maximum capacity. If the output varies over 5%, adjust the 50 $\mu\mu$fd. condenser across the top section of the variable to correct this deviation. The adjustment of this condenser will affect the calibration slightly and may necessitate re-calibration.

Vacuum Tube Voltmeter Adjustments

Reduce the audio output of the oscillator to minimum. Adjust the 10,000 ohm variable resistor in the cathode of the 6SL7 for full scale deflection. Adjust the oscillator gain control for 5 volts output. Next, adjust the one megohm potentiometer in the diode circuit so the meter reads half-scale. With these adjustments the oscillator is ready for use and should have a distortion content of less than 1%. The use of a wave analyzer or distortion meter will allow more precise adjust-

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ments of the negative feedback resistor and the *RC* values. If this equipment is to be used for distortion measurements, a distortion check should be made to indicate that all adjustments are correct.

The design of the vacuum tube voltmeter is such that it will give linear response over the audio frequency range. Since the primary use of the meter is to simply indicate a constant level, no effort was made to calibrate it. The meter can be calibrated up to 6 volts, but above that voltage the scale no longer remains linear. By complicating the vacuum tube voltmeter circuit, a more accurate meter could be constructed. Time and expense did not justify such a procedure.

The cost of parts including chassis, panel, meter, variable condenser, tubes, etc., was $53.25.

—30—

Home Constructed V.T.V.M.

(*Continued from page 35*)

panel will require readjustment when switching the a.c. ranges, due to the contact potential of the diode V_1. If the zero adjusting screw on the face of the meter is properly set, zero adjustment of the pot should not be required when switching from minus or plus polarity with the polarity selecting switch.

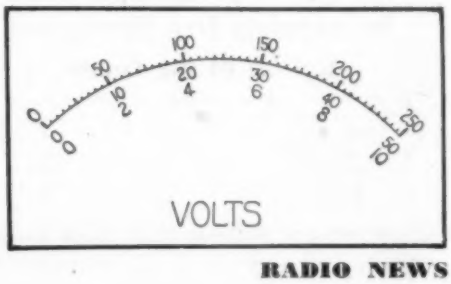
For use with the d.c. voltmeter, a probe with a one megohm resistor included in its tip should be provided to eliminate capacity loading on a circuit when a d.c. voltage is being measured, for instance, measuring the grid voltage of the oscillator tube in a superheterodyne without detuning the oscillator. If this feature is not desired, the one megohm resistor should be connected in the instrument in series with the 6 megohm resistor and ordinary test leads used. If r.f. voltages are to be measured with the a.c. input, leads should be kept as short as possible. If high r.f. is to be measured frequently, it is suggested that a 6H6 be arranged on a probe, to replace V_1, the diode rectifier, so that losses and detuning effects be reduced to a minimum. For all audio and power frequencies this is not necessary.

The power supply is conventional. A 40 mil receiver power transformer is adequate. The rectifier tube depends upon the filament windings available. If the transformer has only one filament winding of 6.3 v., then the rectifier should be a 6X5. If the transformer has a 6.3 v. winding and a 5 v. winding, then a 5Y3 or 80 may be used. The lower the high voltage winding is, the better, as 150 v. d.c. is all that is required. The 8000 ohm resistor which serves as a filter element together with the 2 μfd. condenser may have to be adjusted in value to compensate for the d.c. output voltage of the transformer used. For indicating plates on the front panel, drawings can be made and photographic reproductions cemented to the front panel. In the interest of durability, they may be covered with thin lucite or cellophane.

Be sure that the binding posts or tip jack you use are properly insulated from the front panel. Insulation for about 1500 volts will provide a measure of safety.

When the unit is finished it will pay for itself many times over, particularly where voltages must be measured through high resistance. Actual uses include: receiver tune up (hook d.c. meter terminals to the a.v.c. voltage and tune for maximum indication); amplifier fidelity in FM receivers (an audio oscillator is connected to the amplifier under question and the gain of each stage is measured at 12,000, 400 and 60 c.p.s. Any serious discrepancy in response will be immediately apparent); measuring the d.c. grid voltage of tubes

Fig. 5. Reproduction of a scale for 3" meter. If this were expanded from its present width of 2" to 2¼" it could be used for your meter.



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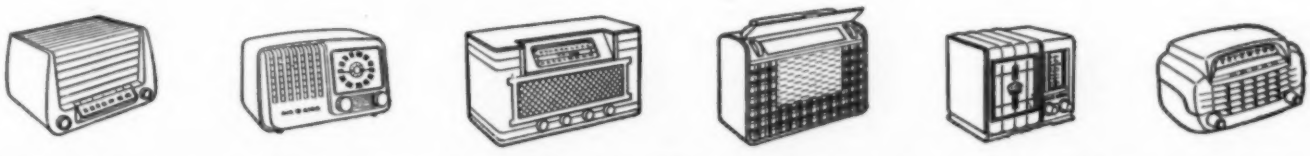

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right at the grid (this is a good way to find leaky coupling condensers); and a thousand and one other uses, in addition to the conventional one of measuring voltages; all of which will repay you for building this vacuum tube voltmeter. —30—

All-Purpose Signal Tracer

(*Continued from page 37*)

the switch type, to disconnect the speaker when the phones are plugged in.

The audio and radio frequency response may be seen from the curves given in Figs. 2 and 3. The values of the circuit constants in the grid of the 1T4 were purposely chosen to have the indicated low frequency response. If a large 60 or 120 cycle hum is superimposed on the signal, the hum frequency will not mask the higher signal frequency since it is attenuated by the high pass filter action. At the same time, the meter has full sensitivity at 400 cycles, which is the usual audio modulating frequency. The sensitivity remains flat in the audio and radio frequency range to 10 mc., above which resonance takes place in the tube and associated components; the sensitivity is increased until about 20 mc., and drops off sharply at higher frequencies.

Details of the physical construction of the unit may be seen from the photograph, Fig. 1. The entire equipment is mounted in a compact gray crackle cabinet containing all components, including the batteries. The 1T4 tube, .0002 μfd. condenser and 20 megohm grid resistor are housed in a drawn brass shielded probe with which any source point of r.f., i.f. or audio may easily be reached for testing, and which mounts on a bracket on the side of the cabinet when not in use. On the front panel are mounted the 4" speaker, the meter, a calibrated attenuator control for the amplifier, the balancing potentiometer for zero setting of the meter, on-off switch, speaker-meter switch, and the phone jack.

The combination of rapid visual as well as aural checking of the signal in this new design makes possible a more thorough testing of the signal from the antenna to the speaker, since the signal in each circuit may be heard for characteristics and fidelity as well as measured for relative strength. Any trouble in a receiver can easily and quickly be isolated. After the initial testing with the volt-ohm-milliammeter for the proper a.c. and d.c. operating voltages, the use of the signal tracer makes it a simple matter to locate defective r.f., i.f. and a.f. components. It becomes easy to find open, shorted or noisy resistors, capacitors, coils, and transformer windings. Bad or weak tubes are checked under actual operating conditions. The sources of intermittent operation, noise, hum, distortion, and any other faults are rapidly isolated. As an example, when testing for an intermittent defect in a receiver, the signal

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tracer may be left connected with the speaker switched on, and while other work is being done the set is at the same time constantly under test. In addition, the same simple procedure which is used in servicing broadcast receivers can be applied to the testing of all other types of communications circuits.

The unit described in this article has been designed and constructed with the purpose of making it the handiest and most conveniently operated instrument of its type. This signal tracer and a battery operated volt-ohm-milliammeter form a combination which may be used for servicing any type of communications equipment under almost any emergency conditions.

—30—

Parasitic Beam Design

(Continued from page 41)

tion, 2 lengths of tubing the same diameter as the elements, 33" long. The additional lengths are to take care of the portion through the center section.

It will be appreciated that, by substituting a wooden supporting mast, this array may be oriented to give vertical polarization. Further, with the array in the horizontal position, the feed line may be carried parallel to the 2 inch tube frame either toward the front or the rear for any desired distance and dropped down from that point. In this application it is to be recommended that the feeders clear the tube frame by at least 3 to 4 inches.

In connection with feeding beam arrays some controversy seems to exist as regards the delta match vs. the

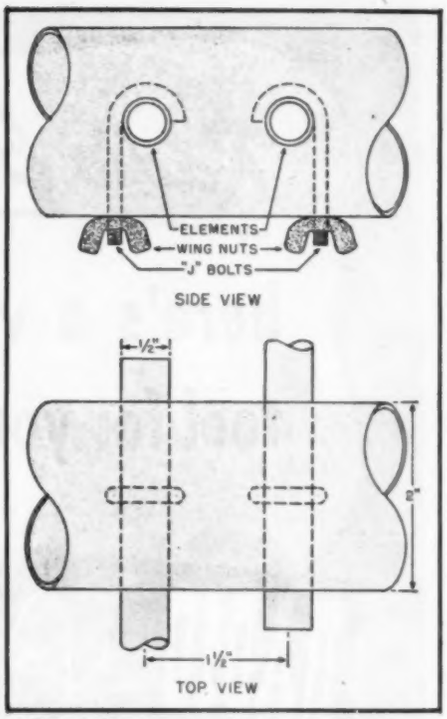

Fig. 4. Construction details for mounting and fastening the antenna elements.

"T" or other matching systems. In considering the efficiency of a feeder system it may be stated that the energy lost is equal to the energy delivered to the sending end of the line minus the energy delivered at the load end of the line. At the lower frequencies, the energy loss consists mainly of the I^2R losses in the line, which manifest themselves as an unusable form of radiant energy, namely heat. As the operating frequency is increased, however, another type of loss must be added to the I^2R loss.

Allen R. Richter, foreign sales manager of Press Wireless Manufacturing Corp., explains some of the features of the new 20,000 watt radio telegraph transmitter to S. L. Chang, radio engineer for the Central News Agency of China. The transmitter pictured is one of two such transmitters built by Press Wireless for the news agency. According to Chung-Chin Kao, former director of the radio division of the agency, the units are to be utilized mainly for radio telegraph, radio teleprinter, and radiophoto operation and will be coordinated with the Press Wireless international network and other communications organizations for the distribution of news.

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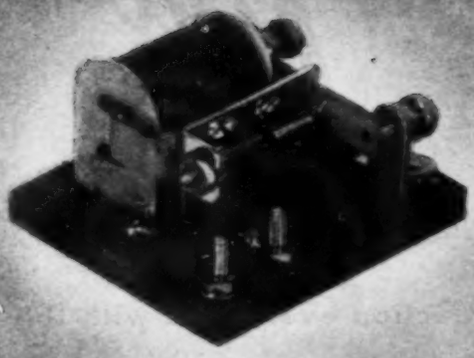

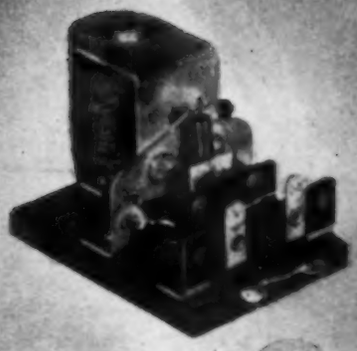

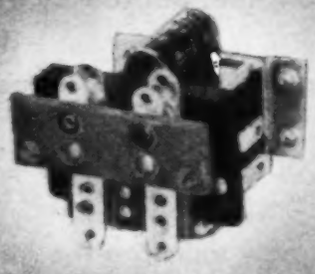

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Our huge inventory of relays is, we believe, the largest and most complete in the country. These relays were made to exacting standards by America's leading manufacturers and are guaranteed in every respect. This equipment will meet your critical quality requirements and save you a large portion of the cost. Our new illustrated Relay Catalog is now ready and will be mailed upon request.

Consult Wells for Quality Radio Parts

We can make immediate delivery of a wide variety of radio components either singly or in quantity. Lists are available on the following items: Volume controls, condensers, resistors, phone jacks and plugs, wafer switches, Micro switches, transmitting tubes and Jones strips.

Wells' Amateur Radio Division

Smart amateurs everywhere are using Wells transmitter parts, tubes and equipment for best performance at the lowest possible cost. Write today for your copy of our Amateur Radio Catalog H-200.

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Please send lists or catalogs on items checked:

☐ Amateur Catalog H-200 ☐ Relay Catalog

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☐ Resistors ☐ Micro Switches ☐ Transmitting Tubes ☐ Wafer Switches

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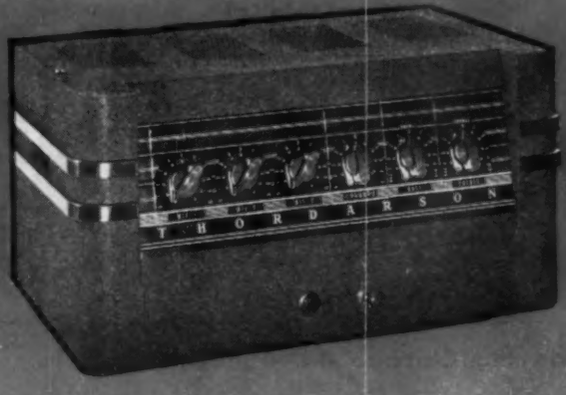
THORDARSON

Amplifiers

25 Watt Amplifier,
Model T31 W25A

8 Watt Amplifier,
Model T30 W08A

30 Watt Amplifier,
Model T31 W50A



THORDARSON . . . MEISSNER . . . RADIART PRODUCTS
LISTED AND RECOMMENDED BY PHOTO-FACT FOLDERS

THE *finest* IN

Insure natural, brilliant sound reproduction every time with this new Thordarson line. Backed by 51 years of outstanding transformer manufacture and 30 years of audio pioneering, these new units are the last word in amplifier quality . . . See them at your jobbers today . . . For sound to satisfy the experts, specify Thordarson.

25 Watt Pre-Amplifier,
Model T31W26

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4237-39 N. LINCOLN AVE., CHICAGO 18, ILL., U. S. A.
CABLE ADDRESS—HARSCHEEL

ELECTRONIC DISTRIBUTOR

ELECTRONIC EQUIPMENT!

MEISSNER

SIGNAL SHIFTER

The top requirement for the complete "Ham Shack" Equipped with built-in band switching. No coils to change, six position switch. Choice of built-in or separate power supply. Ask your jobber for full information today.

COILS

Completely dustproof, unaffected by humidity changes and unexcelled in stability, Meissner coils have been the standard of comparison for 24 years.

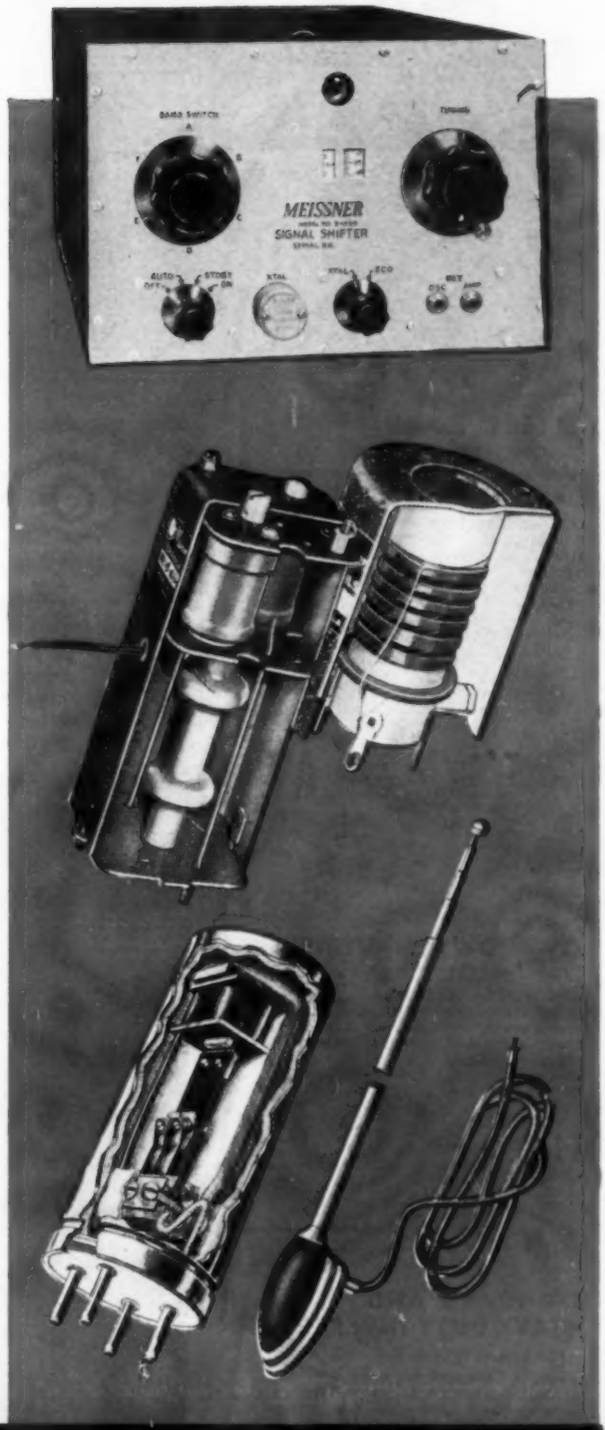
RADIART

VIBRATORS

Look for the Radiart Red Seal at your jobber's . . . Your guarantee of effective, trouble-free performance under all conditions. Radiart Vibrators are sealed against air and moisture to prevent point oxidation . . . a significant advance in vibrator design. Send for free catalog and vibrator guide.

AERIALS

A complete line, cowl, hood and under-hood types, designed for all cars. Permanent "All-Metal Anti-Rattler" reduces mechanical noise and Plastic-Loom Lead facilitates maximum signal transfer efficiency. See this outstanding line at your jobber's today.



MAGUIRE INDUSTRIES
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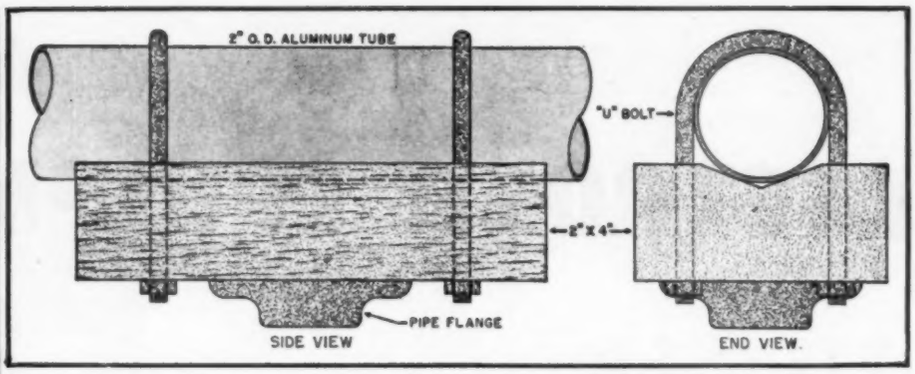


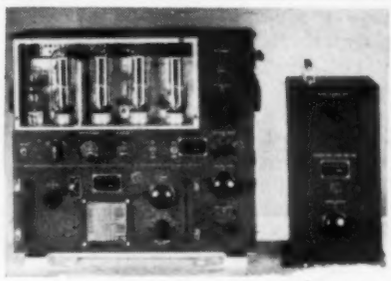
Fig. 5. An ordinary two by four is used to mount the main frame assembly to the mast.

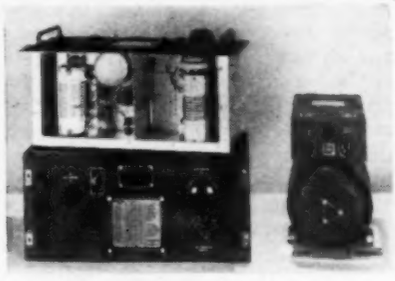
This is the loss due to radiation. At the higher frequencies the spacing between the standard types of feed line becomes an appreciable part of a wavelength and the fields set up by opposing currents in opposing feeder legs do not positively cancel to the point where radiation is eliminated. Many amateurs undoubtedly have noticed a similar effect in high frequency tank circuits in which the minimum plate current dip seems high. Part of the high plate current is due to the fact that at these frequencies the radiation losses from the tank circuit decrease its impedance by lowering its *Q*. Parallel rod tank circuits minimize this effect because they carry currents of equivalent magnitude and opposing direction at closely spaced distances, thus enabling cancellation and reduced radiation resistance.

In the delta match, this situation is aggravated by the fact that the legs of the delta are no longer close together and parallel. In a manner of speaking, it is now possible for the radiation fields generated by currents flowing in opposing legs of the delta to escape almost entirely, because they are at right angles to one another and cancellation is nullified. The resultant field from these two radiation components in all probability does not beneficially supplement the beam pattern or gain; therefore this energy

Technicians working quietly at their tasks at the Daven Laboratories in Newark, New Jersey were startled recently when an electrolytic condenser suddenly "blew its top." The can hit the ceiling with the speed of a bullet while paper and foil spiraled upward in a cloud of smoke. Walter Steinhard, Radio News Staff Photographer, reproduced the phenomena realistically with the original cast of parts.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. N, BUFFALO 3, N. Y.





General Electric 150-Watt Transmitter: *Brand New!*

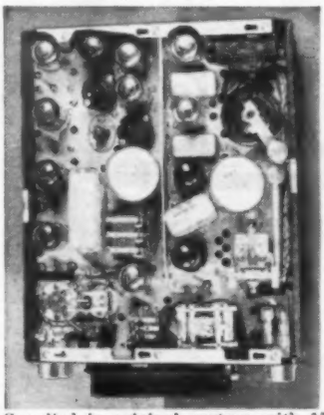
Cost the Government $1800.00. Now Only $44.50!!!
(Can be used by amateurs without any changes or modifications!)

This is the famous transmitter used in U. S. Army bombers and ground stations during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of seven plug-in tuning units which are included. Each unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: **FREQUENCY RANGE:** 200-500 Kc. and 1500-12,500 Kc. (Will operate on 10 and 20 meter band with slight modification.) **OSCILLATOR:** Self-excited, thermal compensated, and hand calibrated. **POWER AMPLIFIER:** Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. **MODULATOR:** Class "B"—uses two 211 tubes. **POWER SUPPLY:** Supplied complete with dynamotor which furnishes 1000 volts at 350 milliamperes. Complete instructions are furnished to operate set from 110V AC. SIZE: 21½x23x9¼ inches. Total shipping weight, 250 lbs., complete with all tubes, dynamotor power supply, seven tuning units, antenna tuning unit, the essential connector plugs, and two profusely illustrated instruction books, all in the original factory packing case. These transmitters are priced to move fast; quantities are limited! Order today, and be the proud owner of one of the finest rigs obtainable.

14-Tube UHF Superheterodyne Receiver

This beautifully constructed receiver was designed especially for Signal Corps communication service, and is one of the finest and most sensitive sets ever manufactured. Operating from 110V, 60 Cycles, this set has two tuned RF stages, tuned converter and oscillator, **FIVE** Slug Tuned I.F. stages, diode detector, tuning eye, and a two stage amplifier that will drive a speaker or phones. The frequency range is 158-210 Mcs. It is a simple matter to operate on other bands by making a slight alteration in the tuning coils. A complete set of tubes is included with each receiver, along with a circuit diagram and parts list. The high-voltage power supply delivers 150 milliamperes, and is well filtered by a heavy-duty choke and three 7 Mfd. oil-filled condensers. This buy of a lifetime cost the government about $700. Amateurs and experimenters will never again be able to purchase fine equipment at such a tremendous saving!.....Only **$39.95**

General Electric RT-1248 15-Tube Transmitter-Receiver



TERRIFIC POWER (20 watts) on any 2 instantly selected, easily pre-adjusted frequencies from 435 to 500 Megacycles. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 MC. IF transformers, plus a 7H7, 7E6's, and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12V operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for telephone use as in a taxicab, or for any kind of remote control applications as with drone airplanes. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice, and for using the receiver as either an AM or FM set. As an FM set, the receiver section of the 1248 is capable of better results than almost any of the commercial FM sets on the market, largely as a result of the superb engineering and meticulous workmanship employed in constructing the converter, oscillator and IF sections. Supplied in original cartons with 15 tubes. Your cost **$29.95.**

10% less if ordered in lots of 2 or more. If desired for marine or mobile use, the dynamotor, which will work on either 12 or 24 V.D.C. and supply all power for the set, is only **$15.00** additional.

BENDIX SCR-522—Very High Frequency Voice Transmitter-Receiver—100 to 156 MC. **This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00.** Crystal Controlled and Amplitude Modulated—High Transmitter Output and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles at high altitudes. Receiver has 10 tubes and transmitter 7 tubes, including 2—832's. Furnished complete with 17 tubes, **AND POWER SUPPLY** for 12 or 24 volts, also remote control boxes and cable connectors. We include complete diagrams and instructions for the simple conversion of the 522 to full 110 Volt 60 Cycle operation. Your cost, Brand New—**$44.50.**

Six Band Communications Receiver

Featuring continuous coverage from 1500 KC to 18000 KC on a direct reading dial with the finest vernier drive to be found on any radio at any price—extreme sensitivity with a high degree of stability—crystal filter and phasing control—BFO—antenna compensation—transmit-receive relay—standard 6 volt tubes. Contains a plate supply dynamotor in compartment within the handsome black crackle finish cabinet, the removal of which leaves plenty of room for installation of a 110V, 60 or 25 cycle supply. These new receivers, which make any civilian communications receiver priced under $200.00 look cheap and shabby by comparison, are only **$44.50.**

Power supply kit for conversion to 110V, 60 cycle, is only $8.50 additional.

SERVICEMEN

Check This Column for Lowest Prices on Quality Parts

SPAGHETTI and flexible plastic tubing. From ⅛" to 1" diameter. Any length you desire 3c a foot.
SPEAKERS-PM dynamic type-4"—$1.95; 5"—$2.05; 6"—$2.20; 8"—$3.95; 10"—$5.95; 12"—$7.50.
CRYSTAL PICK-UPS—Two nationally known makes, one at $2.79, the other at $3.43.
PHONO-MOTORS—110V 60 Cycle with turntable and high quality crystal pick-up.—$7.95.
PHONO CABINETS—Beautiful, portable leatherette covered with or without speaker grille—$7.75.
PHONO AMPLIFIERS—A real AC, 110V, 60 Cycle Amplifier suitable for PA systems and phono amplifier, with a husky power transformer. 6 Watts output. Complete with tubes—$13.00.
RECORD CHANGERS—These are beauties—two post, with featherweight plastic and chrome pick-up, plays 10" and 12" records intermixed! Complete with blue leatherette, or walnut stained cabinet, your choice. Ready for attachment to any radio at the give-away price of only $24.95.
RECORD PLAYERS—Portable Case, single record, complete with 6 Watt A.C. Amplifier previously described. Suitable for auditorium use—$36.95.
PUBLIC ADDRESS AMPLIFIERS—25 Watts peak output, 5 tubes, separate controls for Microphone and Phono inputs. $65.00 value for only $32.00.
CONDENSERS—PAPER TUBULAR 600 WV—.001—8c; .002—8c; .005—9c; .01—9c; .02—9c; .05—10c; .1—10c; .25—23c; .5—36c; **ELECTROLYTICS:** 8mfd. 200v—20c; 10mfd. 35v—20c; 20mfd. 150v—23c; 20/20mfd. 150v—35c; 30/20mfd. 150v—46c; 50mfd. 150v—43c; 8mfd. 475v—35c; 16mfd. 350v—65c; **OIL-CONDENSERS:** 4mfd. 600v—49c; **VARIABLE CONDENSERS:** 3 gang 350mmfd.—83c; 7.5-20mmfd. 1750v. Extra long shaft Hammarlund—only 69c; Miniature Variable condensers: 25mmfd.—39c; 50mmfd.—49c; 75mmfd.—49c; 100mmfd.—54c; 140mmfd.—69c.
PERMEABILITY TUNERS—Attractive slide-rule dial, compactly replaces dial, tuning condensers, oscillator and antenna coils in broadcast band receivers. Special $3.43.
MICROPHONES—All types, nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—93c; other types at lowest prices.
TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS;** Steps up 110v to 220v, or steps down 220v to 110v—$1.95. **FIL. TRANS.;** 6.3v, 8 Amps.—$1.98; 5v, 10 Amps.—$1.98; 150MA, 600v, 6.3 & 5v, transf.—$2.95; 45 MA 2.5v—$1.75; 50 MA-650v, 2.5 & 5v—$1.90; Universal Output Transf. 8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS:** S.Plate to S.Grid. 3:1—79c; S.Plate to P.P. Grids—79c; Heavy Duty Class AB or B, P.P. inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—$2.00.
RELAYS—Guardian SPST 12-24v, has heavy duty 15 Amp. Contacts—$1.25; Guardian 12 to 24v D.C. triple make, single break relay, 5 for $3.75; Sigma supersensitive 2000 ohm D.C. SPDT Relay. (May be adjusted to operate on less than 1 Milliampere)—$2.50.
SELENIUM RECTIFIERS—Dry disc type 1⅛" by 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.
METER RECTIFIERS—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25. Half Wave—90c.
FILTER CHOKES—200, 300, 400, 500 ohm light duty—59c; 200 ohm hvy. dty.—99c; 250 MA, 35 ohms DC res. Made for U. S. Navy. Fully shielded—$1.95.
PLIERS KIT—Khaki case with 4 alloy steel pliers of different designs. Flatnosed, pointed-nose, adjustable parrot-nose, and adjustable slip-joint. Brand new. Complete—$2.08. Screwdriver type **SOCKET WRENCH KITS**—Handle with 6 attachable sockets—69c. **ALCOHOL BLOWTORCH**—99c.
REPLACEMENT CABINETS—Beautiful leatherette cabinet for portable radios—$3.95. Silvertone model 4619, 9x10x16½; model 4465, 5x10x8—$1.50 each.
CHASSIS—ICA. Foundation chassis, and amplifier cabinets and chassis. Complete stock, order by ICA number. Lowest prices.
WIRE—No. 18 POS/ 2 conductor parallel zipcord, brown, 250' spools—$5.25, 500' spools—$9.95, No. 18 PO brown rayon covered parallel lampcord, 500' spools—$12.25. No. 18 SV round rubber covered double wire for wash machines, vacuum cleaners, etc. 250' spools—$6.95. Rubber covered mike cable 250' Spools—$25.00. All kinds hook-up wire—1½c per foot.
PORTABLE AIR COMPRESSOR—Attaches to any ¼ H.P. motor. Just the thing for refinishing radios, painting cars, blowing out chassis, etc. 100 lb. gauge and syphon type gun with 12½ feet of rubber hose included. Pressure adjustable to stay constant at any value up to 100 lbs.—Net price—$22.50.
VOLTMETER—AC or DC. Hickock O to 150V. Almost linear scale (lowest scale division 10V.), with provision for sub-panel illumination—$2.95.
TUBES: A warehouse full, including the new miniatures. Order all types you need. We'll try to supply you completely. Special this month: Sylvania 6V6gt—3 for $2.00; RK-75 or 307 Transmitting tubes only $2.50 each; 6L6G—99c; 6SD7 (replaces 68K7)—59c.

A FREE SCREW DRIVER with All Parts Orders Over $5.00

Famous Collins Autotune Transmitter

This is the well known unit used in Army and Navy planes that features automatic motor tuning of any of 11 front-panel pre-selected frequencies up to 18,100 Kc., as well as the manual tuning possible any time. The transmitter operates on voice, CW, and MCW on all frequencies. This beautifully designed unit uses an 813 final, and push-pull 811's as modulator, measures 23½ x 13¼ x 11, and weighs 70 lbs. Estimated average power output is 150 Watts. Price including dynamotor—**$185.00.**

Write for literature describing any units you wish more information on.

OUR LATEST SPECIALS FOR SERVICEMEN, AMATEURS, AND EXPERIMENTERS

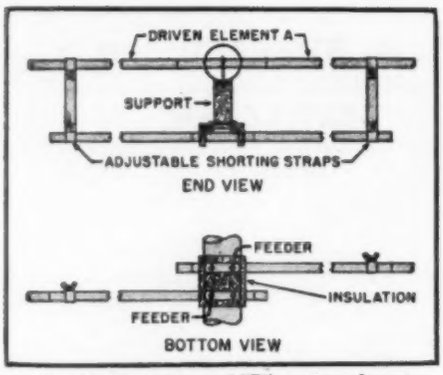


Fig. 6. Two views of "T" section show mechanical details of construction.

may be considered to be lost or wasted. In fact, the legs of the delta matching system are, in reality, a part of the antenna rather than a part of the feeder system, and are improperly polarized and improperly located with respect to the parasitic elements to benefit proper radiation.

In the "T" match, the long sections are close together, parallel and properly located so that spuriously polarized and directed radiation is minimized.

It is not claimed that a large difference in signal level would obtain over a long distance path between the two properly adjusted feed systems. However, it is accepted engineering procedure, when measured results are so difficult to obtain, to employ those practices which are sound. —30—

What's New in Radio

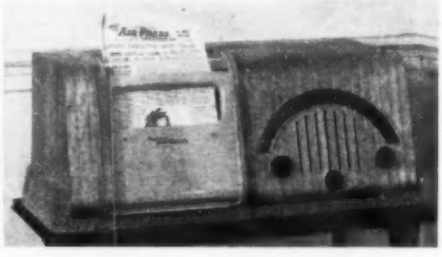
(*Continued from page* 66)

sists of an inverted converter (synchronous converter running from the d.c. side) with an amplidyne mounted on the same shaft. The amplidyne is connected in series with this inverter and bucks or boosts the voltage supplied by the axle-driven generator or battery to maintain constant a.c. voltage and frequency on the output side of the inverter.

The equipment is being manufactured by the Apparatus Department, *General Electric Company,* Schenectady, New York.

FACSIMILE RECEIVER

Persons attending the recent convention of the National Association of Broadcasters witnessed the first public



demonstration of the new *Finch* facsimile receivers for home use.

Available in table and console models, this modern facsimile recorder is combined with an FM-AM home receiver to provide complete home entertainment. The cabinets in which these models are housed are of specially selected woods.

The facsimile recorder is capable of scanning 28 square inches per minute at 105 lines per inch. The radio provides both standard and 88-108 mc. FM sound program reception.

This unit is being manufactured by *Finch Telecommunications, Inc.,* 10 East 40th Street, New York 16, New York.

TUNABLE DIPOLE

A new type dipole for television and FM reception has been announced by *Kings Electronics* of Brooklyn, New York.

A unique feature of this dipole is the fact that the arms of the dipole are adjustable and can be resonated with the wavelength of weak stations. This eliminates ghosts and weak reception on certain stations in low areas, according to the manufacturer.

The adjustable feature of this dipole consists of a u.h.f. element that is calibrated from 1 to 21.5 in half steps. After facing the antenna in the direction of greatest signal strength, should any weak stations develop, this element can be moved in or out, according to a carefully calculated table, and then locked into position. This setting need be made only once.

Because of the adjustable element

A Handy Guide TO SPRAGUE EL SELF-MOUNTING MIDGET CAPACITORS (Can Type)

Easier to install... Tops for Dependability

Time *is* money in radio servicing. Save it—make more of it—by using Sprague Type EL can type dry electrolytic capacitors for every possible replacement use. They're small enough to fit anywhere. They're absolute tops in dependability. And you can mount them in a jiffy, either by direct chassis mounting or by means of their convenient twist prongs. Both bakelite and metal washers are supplied with each unit.

Ask for Sprague Type EL Capacitors by name!

SPRAGUE

PRODUCTS CO., NORTH ADAMS, MASS.

SINGLE SECTION

Catalog No.	Mfd.	Voltage DC working	Dimensions D	Dimensions L
EL-13	3000	10	1 9/16	3
EL-111	1000	15	1	3
EL-121	2000	15	1 9/16	3
EL-142	40	25	9/16	2
EL-112	100	25	3/4	2
EL-152	500	25	1	2 1/16
EL-122	1000	25	1 9/16	2
EL-50	150	50	3/4	2 1/16
EL-55	500	50	1 9/16	2 1/16
EL-31	30	150	9/16	2
EL-51	50	150	3/4	2 1/16
EL-14	40	200	1	2
EL-12	20	250	9/16	2
EL-30	30	250	3/4	2 1/16
EL-42	40	250	1	2
EL-6	60	250	1	2 1/16
EL-203	15	300	9/16	2
EL-33	30	300	1	2
EL-53	50	300	1	2 1/16
EL-123	125	300	1 9/16	3
EL-5	50	350	1	3
EL-125	125	350	1 9/16	3
EL-10	10	400	3/4	2
EL-20	20	400	1	2
EL-80	80	400	1 9/16	2 1/16
EL-1	10	450	9/16	2
EL-15	15	450	1	2
EL-2	20	450	1	2
EL-3	30	450	1	2 1/16
EL-4	40	450	1	3
EL-115	10	525	1	2

DUAL SECTION

EL-242	40-40	25	1	2
EL-250	50-50	50	1	2
EL-221	20-20	150	1	2
EL-231	30-15	150	1	2
EL-230	30-30	150	1	2
EL-24	40-20	150	1	2
EL-35	50-30	150	1	2
EL-25	50-50	150	1	2
EL-26	60-60	150	1	3
EL-101	10-10	250	1	2
EL-120	20-20	250	1	2
EL-245	40-40	250	1	3
EL-21	10-10	300	1	2
EL-253	15-15	300	1	2
EL-22	20-20	300-25	1	2
EL-23	30-30	300-350	1	3
EL-32	30-20	350	1	3
EL-254	15-15	400	1	2 1/16
EL-214	80-10	400	1 9/16	3
EL-210	10-10	450	1	2
EL-151	15-10	450	1	2 1/16
EL-220	20-20	450	1	3
EL-240	40-40	450	1 9/16	3

TRIPLE SECTION

EL-325	20-20-20	25	1	2
EL-335	30-30-30	50	1	2
EL-313	10-30-30	150	1	2
EL-320	20-20-20	150	1	2
EL-224	40-20-20	150	1	2
EL-340	40-40-40	150	1	3
EL-321	30-20-100	150-150-6	1	2
EL-222	20-20-20	150-150-25	1	2
EL-324	30-20-20	150-150-25	1	2
EL-332	30-30-20	150-150-25	1	2
EL-43	30-40-25	150-150-25	1	2
EL-343	40-30-20	150-150-25	1	2
EL-351	50-30-100	150-150-25	1	2
EL-352	50-50-20	150-150-25	1	2 1/16
EL-355	10-15-15	250	1	2
EL-315	10-15-30	250	1	2
EL-354	40-20-20	250	1	3
EL-331	15-15-20	250-250-25	1	2
EL-334	30-30-20	250-250-25	1	2 1/16
EL-314	10-20-30	250-250-350	1	3
EL-316	10-10-10	300	1	2
EL-333	20-20-20	300-300-25	1	2
EL-341	40-15-20	300-300-25	1	2 1/16
EL-102	10-10-20	350-350-25	1	2
EL-153	15-10-20	350-350-25	1	2
EL-326	15-15-20	350-350-25	1	2 1/16
EL-232	20-10-20	350-350-25	1	2 1/16
EL-323	30-20-20	350 350-25	1	3
EL-311	10-10-10	400	1	2 1/16
EL-342	15-15 40	400-400-25	1	2 1/16
EL-322	20-20-20	400-400-25	1	3
EL-310	10-10-10	450	1	2 1/16
EL-344	15-15-10	450	1	3
EL-362	20-15-10	450-300-300	1	3
EL-363	10-10-20	450-350-25	1	2
EL-364	15-20-20	450-350-250	1 9/16	2
EL-345	10-10-10	450-450-25	1	2
EL-202	10-10-20	450-450-25	1	2
EL-312	10-20-20	450-450-25	1	3
EL-353	15-15-20	450-450-25	1	3
EL-205	20-15-20	450-450-25	1	3
EL-350	20-20-20	450-450-25	1	3
EL-330	30-30-20	450-450-25	1 9/16	2 1/16
EL-360	15-15-10	450-450-300	1	3
EL-215	15-5-15	450-450-350	1	3

QUADRUPLE SECTION

EL-434	30-30-30-40	150-150-150-25	1 9/16	2
EL-443	40-40-30-20	150-150-150-25	1 9/16	2
EL-452	50-50-50-20	150-150-150-25	1 9/16	2
EL-422	40-20-10-20	200-200-200-25	1 9/16	2
EL-412	10-10-10-20	300-300-300-25	1 9/16	2
EL-432	40-40-20-20	350-300-300-25	1 9/16	3
EL-415	20-10-5-10	350-350-350-25	1 9/16	2
EL-442	20-20-20-20	400-400-400-25	1 9/16	2 1/16
EL-410	10-10-10-10	450	1 9/16	2
EL-420	20-20-20-20	450	1 9/16	3
EL-421	20-15-15-20	450-350-350-25	1 9/16	2
EL-423	20-15-20-20	450-450-25-25	1 9/16	2
EL-425	20-20-30-30	450-450-300-300	1 9/16	3
EL-431	10-10-10-20	450-450-450-25	1 9/16	2
EL-424	40-30-10-20	450-450-450-25	1 9/16	3

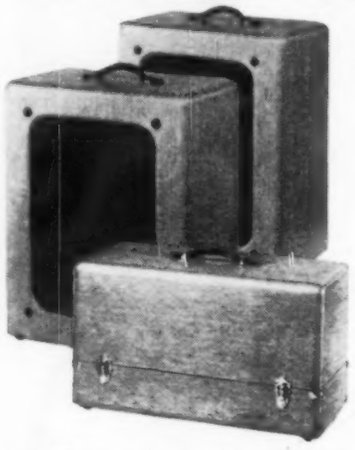
Jobbing Distributing Organization for Products of the Sprague Electric Company

this dipole is capable of receiving an extremely broad band of FM and television frequencies, including black and white, color and experimental television; FM; 1¼ meter amateur; glide paths; airport controls; and fixed and mobile stations.

Kings Electronics, 372 Classon Avenue, Brooklyn 5, New York will supply prices and additional details upon request.

PORTABLE SOUND SYSTEM

Newcomb Audio Products Company of Los Angeles has developed a new portable sound system, one of a series



of portable units built around the standard and deluxe Newcomb amplifiers, and ranging from 10 to 60 watts power output.

The 3-case system includes a 30 watt amplifier with two 12", wide range loudspeakers. The cases are of plywood with airplane type fabricoid finish. Each speaker is supplied with 50 feet of detachable cable.

The combined shipping weight of the Model KX-30R12A is 147 pounds.

Complete information of this unit will be supplied by *Newcomb Audio Products Company,* 2815 S. Hill Street, Los Angeles 7, California, to those requesting it.

V.T.V.M.

The Type 1800-A vacuum tube voltmeter is the newest addition to the line of test instruments offered by *General Radio Company* of Cambridge, Massachusetts.

This unit is smaller, lighter and easier to use than the company's Type 726-A which this model supersedes. In addition, the v.t.v.m. reads d.c. as well as a.c. voltages and can be used at much higher frequencies.

The range of a.c. voltage measurement is .1 to 150 volts. Frequency correction curves for both resonance and transit-time effects for frequencies up to 500 mc. are supplied. Where absolute voltage readings are not required, the instrument can be used as a voltage indicator up to 2500 mc. A single zero setting serves for all ranges. The d.c. voltage range is between .01 and 150 volts. The rated accuracy for both a.c. and d.c. measurements is ± 2%.

The probe is supplied with a variety

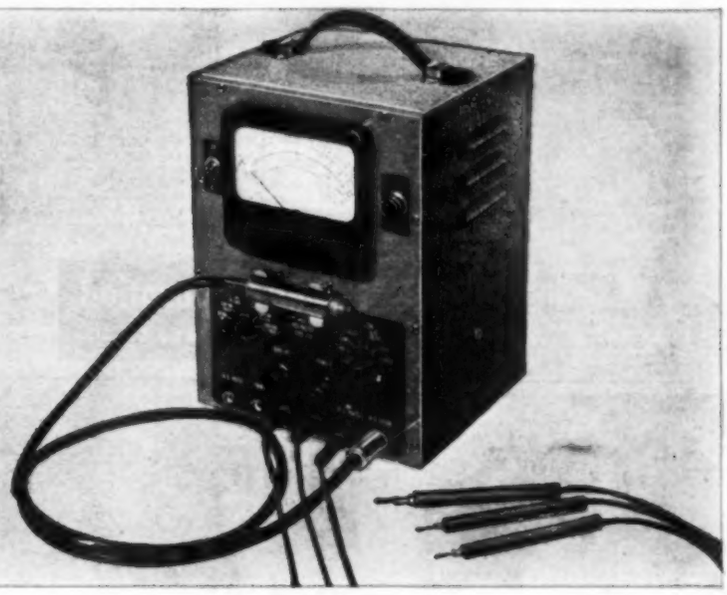
SYLVANIA NEWS
RADIO SERVICE EDITION

JAN. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1947

ONE DEVICE NOW USED BY RADIO SERVICEMEN FOR GREAT VARIETY OF TESTS

Electrical Measurements Made Easy With New Sylvania Unit!

The **SYLVANIA Poly (MULTI-PURPOSE) Meter**



Radio servicemen now can use the new Sylvania Poly (MULTI-PURPOSE) Meter type 134 to facilitate a multitude of electronic measurements and tests to radio equipment.

This product of Sylvania Research is stabilized against errors due to voltage variations or gas current in tubes. All accessories included. See your Sylvania Distributor.

CHARACTERISTICS AND SPECIAL FEATURES

Tests audio, A.C. and R.F. voltages from 20 cps to 300 mc through use of proximity fuze-type tube built into handy probe. Full scale range of 3, 10, 30, 100, 300.

Measures D.C. from .1 to 1,000 volts in full scale ranges of 3, 10, 30, 100, 300, 1,000.

Measures D.C. current from .1 milliampere to 10 amperes in full scale ranges of 3, 10, 30, 100, 300, 1,000 milliamperes and 10 amperes.

Measures resistance from ½ ohm to 1,000 megohms in full scale ranges of 1,000, 10,000, 100,000 ohms and 1, 10, 1,000 megohms.

ACCURACY

D.C. ranges ±3% of full scale.

A.C. ranges ±5% of full scale up to 30 volts and ±7% above 30 volts.

R.F. ranges ±5% of full scale up to 10 volts; ±7% from 10-100 volts; ±10% on 300 volt range.

Ohms ±6% to the left of ½ scale; ±13% to the left of ¾ scale.

Current ±3% of full scale on all but 10 ampere scale which provides ±5% of full scale.

INPUT IMPEDANCES

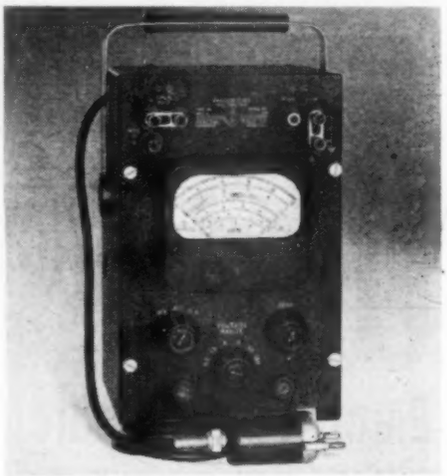
R.F. ranges—2.7 megohms resistance shunted by approximately 3 mmf. capacity.

A.C. ranges—2.7 megohms resistance shunted by approximately 40 mmf. capacity.

D.C. ranges—16 megohms resistance.

Remember the Sylvania Poly (MULTI-PURPOSE) Meter type 134. It's beautifully styled, compactly designed, has easily read meter and dials.

of fittings, including both coaxial and banana-plug terminals and a 50 ohm disc resistor for coaxial line measurements. The probe cap is removable to give a minimum input capacitance of



3.1 $\mu\mu$fd. The input resistance at low frequencies is 25 megohms, decreasing at higher frequencies owing to loss in the shunt capacitance. Two input resistances are available for d.c. measurements, 10 megohms and open grid. Power supply for this unit is 100 to 130 or 200 to 260 volts, 50 or 60 cycles. A voltage regulated power supply is used.

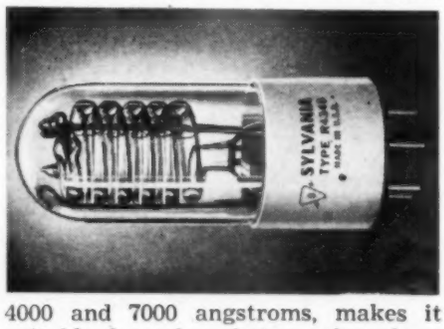
Prices and additional details will be furnished by *General Radio Company*, 275 Massachusetts Avenue, Cambridge 39, Massachusetts.

FLASH TUBE

Sylvania Electric Products Inc. has recently announced the availability of a new electronic flash tube which provides increased light output and has been specially designed for black and white and color photography.

This new type R4340 tube provides a peak output of 48 million lumens or four times the amount of light produced by the type R4330 previously announced by the company.

Daylight quality of the light, which produces an almost flat curve between



4000 and 7000 angstroms, makes it suitable for color photography where both intensity and color characteristics are important.

Tube life is rated at more than 10,000 flashes with a maximum repetition rate of four times a minute. This tube is suitable for condenser discharge circuits where a 120 μfd. condenser is discharged at 2500 volts. These circuit values provide a flash of approximately 1/5000th of a second duration.

Further information on the type

SUN RADIO • HOME OF NATIONALLY KNOWN RADIO PARTS

Brand New STANDARD BRAND TUBES! UP TO 80% OFF

Number	Price	Number	Price	Number	Price
0Z4	$ .45	6F5	$ 1.00	12SA7GT	$ .30
1A5GT	1.00	6F6	.95	12SF5GT	.00
1A6	.80	6F7	1.50	12SJ7GT	.10
1B4	.80	6G6	1.00	12SK7GT	.10
1B7	.80	6H6	.75	12SL7GT	.20
1C5GT	1.00	6J5	.80	12SN7GT	.95
1D7	.85	6J7	.15	12SQ7GT	.10
1D8GT	1.10	6J8	1.30	12SR7	.00
1E4	.80	6K6	.85	14A7	.50
1E5	.90	6K7	.85	14B6	.40
1E7	1.00	6K8	1.30	14B8	.60
1F4	.80	6L5	.10	14C5	.60
1F5	.80	6L6G	1.50	14C7	.60
1F7	.90	6L7	1.40	14F7	.60
1G4	1.30	6N7	1.40	14H7	.60
1G6	1.25	6P5	.80	14J7	.60
1H4	.70	6P7	1.40	14N7	.60
1H6	.80	6Q7	1.30	14Q7	.20
1J5	.75	6R7	1.40	14S7	.60
1J6	.80	6S7	1.20	14W7	.85
1LA4	.95	6SA7	1.00	14Y4	.60
1LB4	.95	6SF5	.70	18	.25
1LC5	.95	6SJ7GT	.70	19	.00
1LD5	.95	6SK7GT	.80	20	.75
1LH4	.95	6SL7GT	1.00	22	1.00
1LN5	.95	6SN7GT	.85	24A	.90
1N6	.80	6SQ7GT	1.00	26	.75
1R5	1.25	6T7	1.00	27	.70
1S4	1.25	6G5	.95	30	1.00
1S5	1.25	6U6GT	1.00	31	1.00
1T4	1.25	6U7	1.00	33	1.00
1T5	1.50	6V6	1.10	34	.80
2A6	.75	6V7	1.00	35/51	1.00
2A7	.65	6W7	1.20	35/24	.80
2B7	.75	6X5GT	1.00	36	1.00
2E5	.65	6Y6G	1.00	37	.75
2X2/879	.90	7A4	1.00	38	.85
2Z2 G84	.45	7A5	1.00	39/44	.80
3A8	.95	7A6	1.00	41	.85
3S4	1.25	7A7	1.00	45	.80
5U4	1.00	7B4	1.00	46	1.00
5V4	1.60	7B5	1.00	49	.95
5X4	1.10	7B6	1.00	50	1.75
5Y3GT	.70	7B8	1.30	55	.50
5Y4	.75	7C5	1.00	56	.80
5Z3	.95	7C7	1.00	59	.80
6A5	1.70	7E6	1.00	76	.75
6A6	.80	7E7	1.30	77	.75
6A8	1.00	7F7	1.30	78	.75
6A5G	.70	7H7	1.50	79	.85
6AC5GT	1.00	7J7	1.50	80	.60
6AF5	1.00	7L7	1.50	81	1.50
6AF6	1.60	7N7	1.50	82	.85
6B4	1.50	7Q7	1.00	83	1.30
6B7	.95	7R7	1.30	83V	1.95
6B8	1.00	7S7	1.50	89	.40
6C5	.95	7V7	1.80	99	1.50
6C6	1.00	7W7	1.80	117L7GT	2.35
6C7	.45	7Y4	1.30	117Z6GT	1.60
6C8	1.25	12A5	1.50	XXB	1.50
6D6	.75	12F5GT	1.00	XXFM	1.50
6D7	1.00	12J5GT	1.00	XXL	1.50

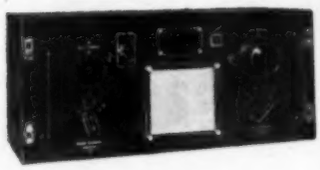
An additional 10% discount will be given on all orders for 100 tubes or more!

WAR SURPLUS EQUIPMENT!

. . . AT A FRACTION OF THEIR ORIGINAL GOVERNMENT COST!

AIRCRAFT INTER-COM AMPLIFIER

Comes completely wired in aluminum cabinet with the following: 2—12A6, 2—12J5 Tubes, 1—Bath tub condenser, 3—Can Filter Condensers, 12—Precision Resistors, 6—Mica Condensers, 4—Low loss octal Sockets, Shielded input and output Transformers, 2—shielded R.F. chokes, 1—S.P.S.T. toggle switch, 28 V D.C. Dynamotor. Sun Radio furnishes the instructions for easy conversion to Hi-fidelity phono or speech amplifier. **$8.95**



R.F. TUNING UNIT

$3.89

Comes in a beautiful black crackled aluminum cabinet with two Variable Transmitting Condensers and two Vernier dials, one heavy duty ceramic four position wafer switch, two or more mica condensers 2,500 Working Volts and coils wound on porcelain ribbed forms.

No. TU5B—1500 to 3000 KC
No. TU6B—3000 to 4500 KC
No. TU7B—4500 to 6200 KC
No. TU8B—6200 to 7700 KC
No. TU10B—10,000 to 12,500 KC

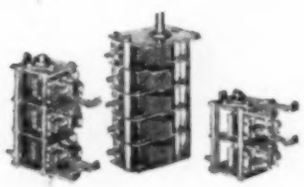
Please specify model

SPEAKERS

Navy Type waterproof speakers Stromberg-Carlson and RCA 4½ ft. reentrance trumpet with 25 Watt PM driver unit and line matching transformer, $125 value for $32.50. 25 Watt PM driver unit with line-matching transformer and waterproof projector mounted in a heavy duty round metal baffle. Ideal for communication receivers and public address systems at the lowest price ever offered! ! **$14.95**

LOW FREQUENCY RECEIVER BC-344

Brand new, operates on 110 volts A.C. complete with 10 tubes, 6" P.M. speaker, encased in metal baffle . . . tunes 150 to 1500 KC. A "hot" low frequency receiver at this spectacularly low price . . . only **$85.60**



TUNING CONDENSERS

Beautifully designed with ceramic insulation.

2 gang, split stator, 36 mmfd. **$1.49**

3 gang, split stator, 36 mmfd. **$1.99**
(Easily converted to 365 mmfd. per section)

5 gang, 365 mmfd. per section **$2.95**

The greatest value ever offered in tuning condensers!

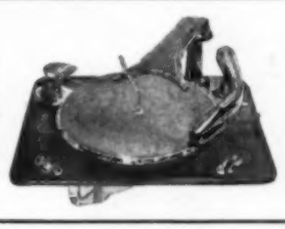
Additional 10% discounts in lots of 12 or more

GARRARD RECORD CHANGER

RC/60 110 V.A.C. operation 50/60 cycles intermixes 10 and 12 inch records, automatically cuts off after last record, variable speed motors, comes with new permanent needle with less than one oz. needle pressure..... **$63.00**

Universal model same as above but operates AC 110/130 and 200/250 volts. **$73.00**

Walnut Wood Cabinet for above $24.00



F.M. TRANSMITTER & RECEIVER

BC 683—FM—10 tube receiver less power supply **$39.95**

BC 684—FM—35 Watt Transmitter less crystal and power supply..... **$39.95**

Combination BC 683 and BC 684 Tunes 27 to 38.9 MC..... **$69.95**

RADAR RECEIVER BC—1068A

Guaranteed excellent condition. It is a Hot receiver for Ham and Television experimenters, tunes 174 to 210 mc. contains 2 R.F. and 5 I.F. stages. Complete with 110 volt AC power supply and 14 tubes..... **$39.95**

Hallicrafters Panoramic Adaptor Available now for immediate delivery. **$99.50**

SCR-195

New Walkie Talkies SCR-195 tunes 52.8 to 65.8 MC. 2 units complete and ready to operate **$119.90**

PROVAC V.T.V.M.

This beautiful V.T.V. Meter that has met the demands of thousands of Radio engineers and servicemen.

DCV Rangers 0 to 3-10-100-300-1000. 11 Meg. ohm input resistance 3% ± ACV Range 0 to 10-30-100-300-1000. 1000 ohms per volt. R. F. Range. 0 to 3-10-30-50 Frequency range 60 CPS to 100 Megacycles ohm Meter Range 0 to 1000-10,000-100,000; 1 meg.-10 meg-1000 meg. Complete **$59.50**

GON-SET CONVERTERS AM & FM

AM
20 meters **$39.95**
10 and 11 meters **39.95**
6 meters **39.95**
Special-Noise-silencer **8.25**

FM New Bands
88 MC to 96 MC
96 MC to 104 MC
100 MC to 108 MC
$14.95

WESTON No. 689 OHM METER

Scale 0-10-1000
Scale to read 1/20 ohm
Complete with leather case..... **$14.97**

SUN RADIO
OF WASHINGTON, D. C.

938 F STREET, N. W. WASH. 4, D. C.

ALL ITEMS F.O.B., WASHINGTON, D. C.
All orders $30.00 or less cash with order. Above $30.00, 25 percent with order balance C.O.D. Foreign orders cash with all orders plus exchange rate.

R4340 will be furnished by the *Electronics Division, Sylvania Electric Products Inc.*, 500 Fifth Avenue, New York 18, New York.

VARIO-TUNER

Electronic Laboratories, Inc. is currently offering their new E-L Vario-Tuner to the trade.

This permeability type radio tuner may be used in table model receivers, eliminating the need for tuning condensers and coils while providing high gain operation.

This unit provides full band coverage from 540 to 1620 kc., a simplified circuit which is ready to be connected to the radio, no backlash and new ribbon drive, simple installation, and short-wave spread-band tuning.

REDUCING NUMBER OF CAPACITORS OR RESISTORS IN DECADE BOXES

TEN-POINT resistance or capacitance decade boxes often are built by laboratory workers. Radio servicemen and experimenters build less accurate versions of the same units and use them as resistor or capacitor substitution boxes. In both cases, it is customary to employ ten capacitors or resistors in each such box, in combination with a single-pole, 10-contact rotary selector switch.

By using the ideas illustrated by the accompanying schematics, the number of capacitors required in a decade box to obtain ten successive positions can be cut down to four, and the number of resistors cut down to five. Where precision capacitors or resistors are employed, this will afford a substantial saving of money and space. And in the case of substitution boxes, where accuracy requirements are less stringent, but components still must be hand-picked, the saving again is worthwhile. A 4-pole rotary switch does this unique job in the capacitor decade (Fig. 2) and a 2-pole switch is employed in the resistor decade (Fig. 1).

In the resistor decade, 1-, 3-, 5-, 2-, and 4-ohm resistors are connected in series in that order, as shown in Fig. 1A. The double-pole switch (S_1-S_2) selects single units from 1 to 5 ohms (See Fig. 1B) and appropriate series combinations of resistors from 6 to 10 ohms. This is a units decade. For a tens decade, use 10, 30, 50, 20, and 40-ohm resistors; for a hundreds decade, use 100-, 300-, 500-, 200-, and 400-ohm resistors; for a thousands decade, use 1000-, 3000-, 5000-, 2000-, and 4000-ohm resistors; etc.

In the capacitor decade, 10-, 20-, 30-, and 40-$\mu\mu$fd. capacitors are arranged as shown in Fig. 2A. The bottom pole (S_4) of the 4-pole selector switch (S_1-S_2-S_3-S_4) selects single units from 10 to 40 $\mu\mu$fd. and appropriate parallel combinations of capacitors (See Fig. 2B) from 50 to 100 $\mu\mu$fd. This is a tens decade. Homemade "units" capacitance decades are not very practicable because stray capacitances are apt to be of the same order of magnitude as the decade capacitances. For a hundreds decade, use 100-, 200-, 300-, and 400-$\mu\mu$fd. capacitors; for a thousands decade, use 1000-, 2000-, 3000-, and 4000-$\mu\mu$fd. capacitors; etc.

—30—

Fig. 1. Resistor decade.

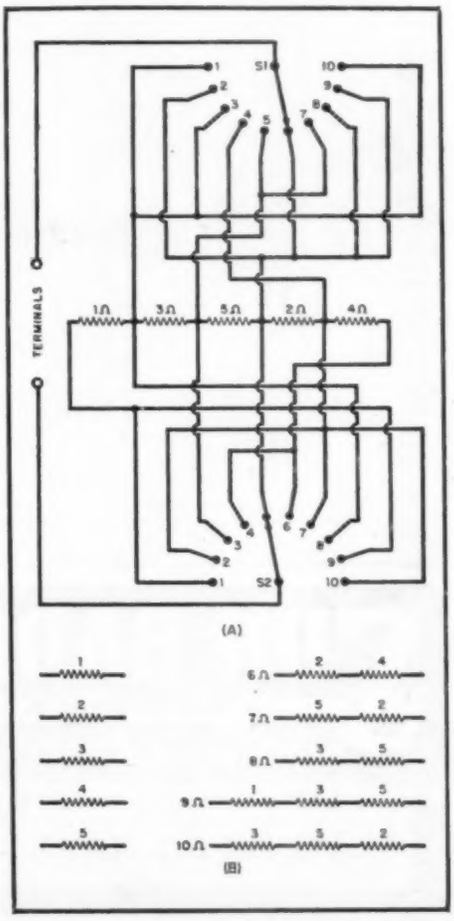
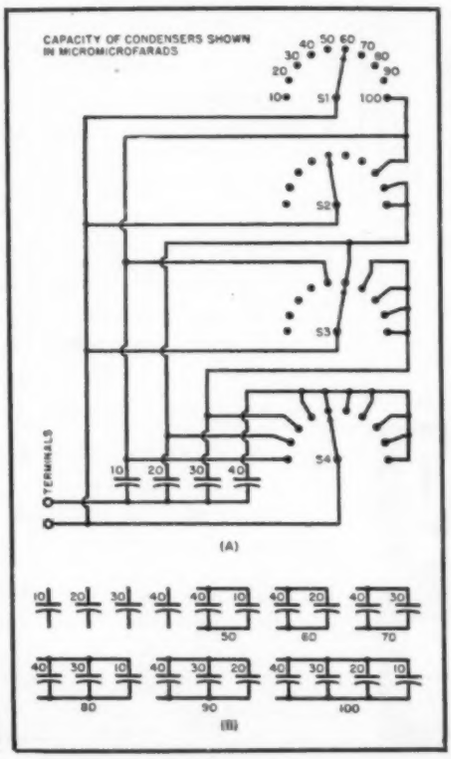
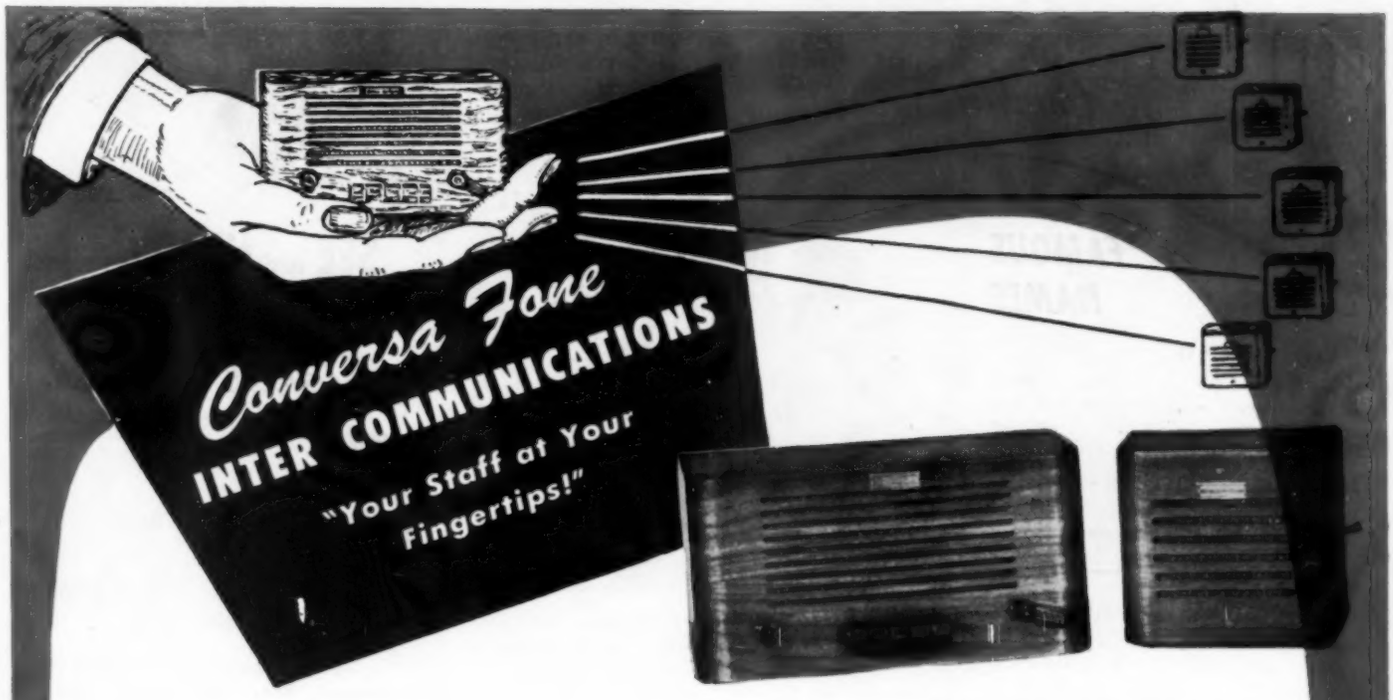


Fig. 2. Capacitor decade.





MASTER STATION MODEL MS5

- Luxurious, Handsome Cabinets Fashioned of Choice Walnut Woods
- Fingertip Volume Control
- Four-Piece Amplifier (no ballast tube)
- Four-Inch Alnico Speakers No. 5
- Designed for Home, Office, Factory
- Five Push Buttons for Instantly Selecting Sub Stations

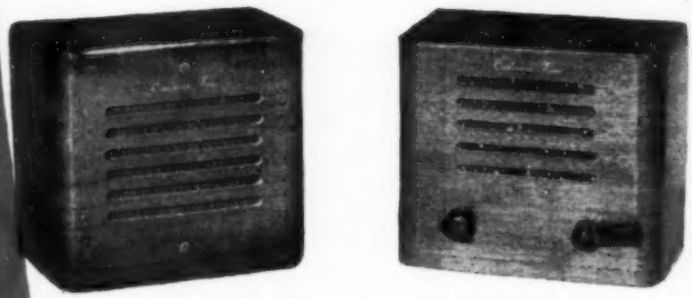
Standard Equipment: One Sub Station and One Master Station. As requirements warrant, up to four more Sub Stations may be added. Master Station is silent during normal operation and Sub Stations can initiate calls to Master but cannot call or answer one another. Installation is exceedingly simple. Master and Sub packed in one carton. Additional sub-stations packed four to a carton.

Additional Sub Stations.....EA. $8.25

NET PRICE.....$35.22

Immediate Delivery

- **FOR VERSATILITY • FOR PERFORMANCE**
- **FOR SIMPLE OPERATION AND INSTALLATION . . . IT'S CONVERSA FONE**



COMBINATION KIT MODEL MS1

- DeLuxe Walnut Cabinets
- 4" PM Alnico No. 5 Speaker
- Three-Tube, High-Gain Amplifiers (1—12SC7; 1—12A6; 1—35Z5)
- Excellent Tone Quality
- Volume Control
- Ideal for Two-Way Communication in Home, Office, or Factory

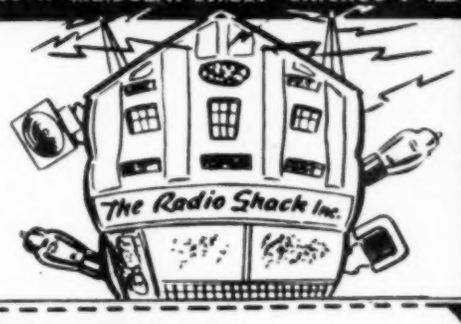
Standard Equipment: One Master Station and one Sub Station. Amazingly simple operation and installation. A low cost unit that can ideally fill any two way communication need. Packed one master and one sub to a carton.

Net Price $25.46

Immediate Delivery

The Radio Shack Inc.

630 W RANDOLPH STREET CHICAGO 6 ILL.



The Radio Shack Inc. of Chicago
630 West Randolph Street, Chicago 6, Illinois

.....Please send literature on Conversa Fone Inter Office Communicators.

.....Send Radio Shack's free illustrated catalog of thousands of radio and electronic parts values.

.....Please ship—Model MS5—Model MS1—Additional Sub Stations.

Name .....

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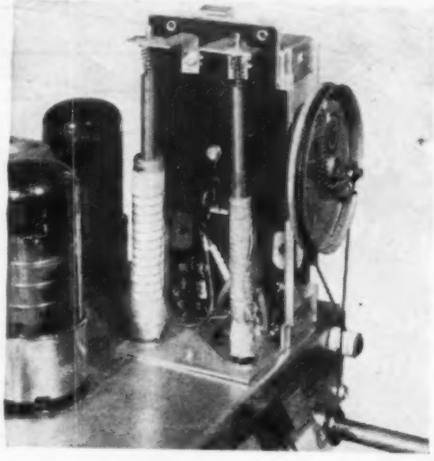
City .....Zone.....State.....

25% Deposit required on all C.O.D. orders

Send coupon TODAY

Suitable for inclusion in radio construction kits, for radio service dealers, amateurs, experimenters, engineers, radio schools and laboratories, the

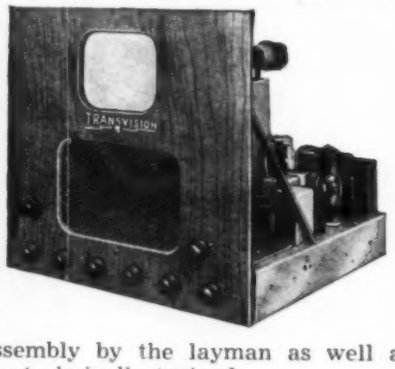


tuner is packaged with complete details for the construction of a complete 6-tube radio receiver, together with a parts list.

Electronic Laboratories, Inc., Indianapolis 4, Indiana, will supply further details and prices on these units.

TELEVISION KIT

Transvision, Inc. of New Rochelle, New York will soon begin distribution of a television kit, engineered for easy



assembly by the layman as well as the technically trained.

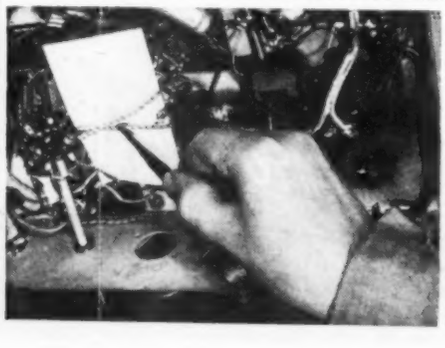
The kit will contain, in addition to all the components, the necessary solder and wire and complete directions.

REPLACING SHORT-WAVE SWITCH

IT IS important that wires to short-wave switches or coils be replaced in original position, after making repairs or cleaning switch.

Any new leads must be of the same length as the original. Such wiring should be dressed as found. See photo.

.....H.L.



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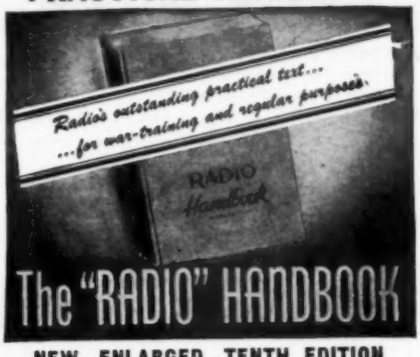

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The picture tube included in the kit is a seven inch electrostatic type, giving a large enough picture to be viewed by 8 to 15 people. The receiver incorporates 18 tubes, 3 i.f. picture stages, 3.5 megacycle bandwidth in the picture circuit, a newly designed sweep circuit, and 3000 volts second anode supply which provides sufficient brilliance to allow daylight viewing.

Further information on these kits may be secured by writing the manufacturer, *Transvision, Inc.*, 144 Union Avenue, New Rochelle, New York.

SPECIAL TRAINING FILMS

Because of the rapid increase in turnover among sales personnel, the problem of training suitable sales help is a real one for the radio and appliance retailer.

In order to cut down training time,

the *Jam Handy* organization has recently completed a series of five training films, the purpose of which is to help train sales personnel in proper floor conduct and customer contact in the postwar era.

Each of these films is accompanied by a disc record carrying commentary and voices. An instructor's manual accompanies the films and records, providing a pattern of procedure in holding visualized meetings. Subjects covered in this series include; friendliness, attentiveness, helpfulness, sincerity, and enthusiasm.

ECA TABLE MODEL

Electronic Corporation of America has recently announced that their Model 201 table receiver will be released from production shortly.

This new model, which employs

miniature tubes, is a 5 tube receiver housed in a two-tone, wrap-around wood cabinet.

The Model 201 also features a new type of circuit which reduces hum output, and an improved i.f. amplifying

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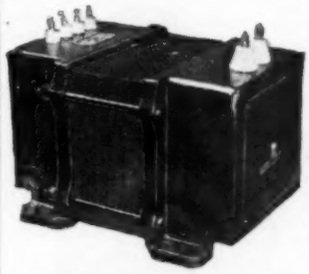

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Electronic Corporation of America, 170 53 St., Brooklyn 32, New York will furnish additional details upon request.

NEW DIA-CONE SPEAKER

Altec Lansing Corporation has recently announced the addition of the Model 600 Dia-Cone speaker to their line.

Designed as a production unit for home radio, phonograph, music system and FM reception, this speaker uses the exclusive Dia-Cone principle of reproducing low frequencies and high frequencies on separate diaphragms.

The Model 600 speaker is mounted in a 12" frame and uses an Alnico V permanent magnet and a 3" wound aluminum voice coil to which is mounted a domed aluminum alloy

metal diaphragm and a seamless molded cone. The seamless molded cone vibrates as a piston with the voice coil to reproduce all lower frequencies up to approximately 2000 cycles.

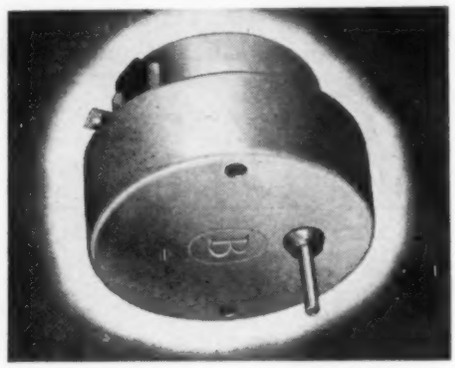
Although normally supplied without a cabinet, various types and sizes of cabinets are available for mounting this speaker.

Inquiries regarding this model should be addressed to *Altec Lansing Corporation,* 250 West 57th Street, New York 19, New York.

NEW TIMING MOTOR

Just announced by the *A. W. Haydon Company* of Waterbury, Connecticut, is their new Circle B, timing motor which incorporates several new features.

Exceptionally compact, the Circle B Timing Motor easily fits in a 2" circle.



Among the other features of this motor are: through holes for mounting, easy-to-solder terminals, no straggly lead wires, no ears sticking out, etc.

Production of this motor is limited, at the present, to 1 and 5 r.p.m. speeds, with other speeds available. Voltage ratings are 110, 220 and 24 volts at 60 cycles.

Complete information and prices will be furnished by writing direct to *A. W. Haydon Company,* Department P, Waterbury, Connecticut.

MINIATURE SELENIUM RECTIFIER

The Seletron Division of *Radio Receptor Company, Inc.* is currently in production on a new miniature five

"Do you mean you milked me of all those answers knowing full well you weren't going to give me anything?"

RADIO NEWS

New! Series 200

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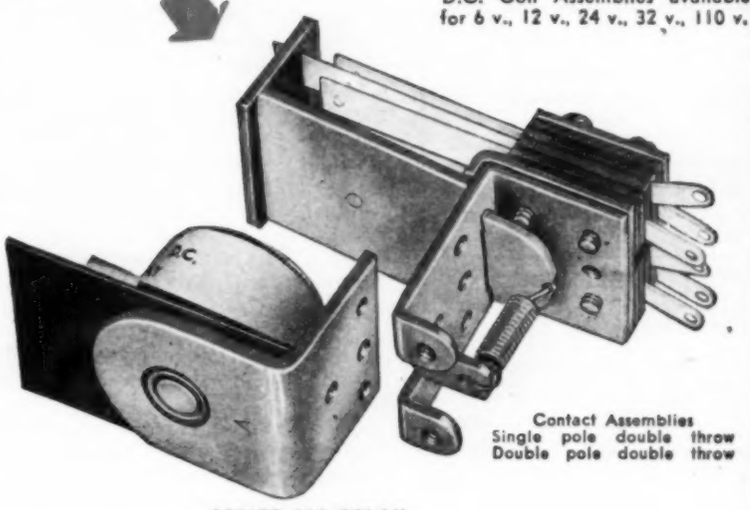
★Two basic parts—a coil assembly and a contact assembly—comprise this simple, yet versatile relay. The coil assembly consists of the coil and field piece. The contact assembly consists of switch blades, armature, return spring, and mounting bracket. The coil and contact assembly are easily aligned by two locator pins on the back end of the contact assembly which fit into two holes on the coil assembly. They are then rigidly held together with the two screws and lock washers. Assembly takes only a few seconds and requires no adjustment on factory built units.



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Four a-c coils and five d-c coils are available. Interchangeability of coils enables you to operate the Series 200 relay on one voltage or current and change it over to operate on another type simply by changing coils.

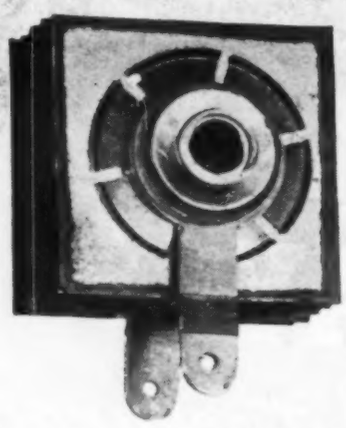
Your jobber has this sensational new relay on sale now. Ask him about it. Or write for descriptive bulletin.

GUARDIAN ELECTRIC

1630-A W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

plate selenium rectifier, the 5M1, which has been designed to replace such rec-



tifier tubes as 26Z5, 35Z5, 117Z6, 0Y4, and others in a.c.-d.c. battery portables, consoles and vibrator power supplies.

This unit, 1" x 1" in size, features high current capacity and low loss.

The 5M1 is designed to be used with 25 ohm series resistor and maximum capacitance of 40 μfd. Maximum continuous current is 100 ma. at an ambient temperature of 35 degrees C. The d.c. output voltage and maximum a.c. input voltage is 130 volts.

Radio Receptor Company, Inc., 251 West 19th Street, New York 11, New York, will furnish additional data on request.

FM CONVERTER

Waterproof Electric Company of Burbank, California is currently in production on a small unit for converting FM receivers operating on the 42-50 mc. band to the new FM broadcast band.

This unit requires no adjustment or tuning operations. The receiver operates in the usual manner.

The converter unit measures approximately 1½"x 2"x 4" and weighs less than a pound.

Complete details and prices on this

unit will be supplied by *Waterproof Electric Company*, 72 East Verdugo Avenue, Burbank, California.

NEW VOLTOHMYST

The Test and Measuring Equipment Section of the *RCA Engineering Products Department* has just announced an advanced model "Voltohmyst" designed for the servicing of industrial and radio equipment using frequencies up to 250 mc.

Employing a newly developed diode probe and capable of measuring peak-to-peak voltages at very high frequencies, the new meter, designated as the *RCA* WV-75A, features circuit innovations which make the meter suitable for high frequency work.

The instrument comprises a v.h.f. voltmeter, audio voltmeter, a.c. voltmeter, d.c. voltmeter, ohmmeter and FM indicator. Special features of this unit include the ability to read both a.c. and d.c. voltages up to 1000 volts and an electronic monitoring circuit which makes the meter virtually burn-out proof. A polarity reversing switch which eliminates the necessity of changing leads is another new feature.

A full wave rectifier, built into the a.c. probe, makes possible the reading of both negative and positive voltage peaks even at the higher frequencies. The diode probe contains a standard

Army-Navy integral female fitting for direct connection to a coaxial line. Measurements at high frequencies are

NEXT MONTH

TRANSMISSION LINE SYSTEMS FOR FM AND TELEVISION HOME RECEIVERS

Servicemen must know the facts presented in this article to understand higher frequency antenna system installations.

RETAILING BASICS THAT PAY OFF

A New York University Professor analyzes important facts for new and old dealers.

A 5-TUBE HAM SUPER

Construction details of a low cost short-wave receiver.

SIMPLE 10-METER CONVERTER

An easy method for adapting war surplus receivers to the 10-meter band.

CAPACITY OPERATED RELAYS

Experimenters and builders of gadgets will find many applications for these circuits which are actuated by body capacity.

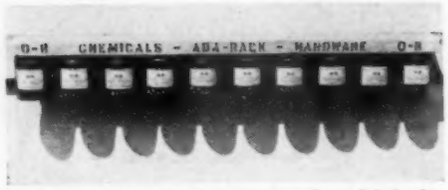
made by direct contact with the central pin and the ground ring at the end of the diode probe, while an alligator clip for the central pin and the short ground lead serve as adaptors for voltage measurements at lower frequencies.

Details of this unit will be furnished by the *Test and Measuring Equipment Section, RCA Victor Division, Radio Corporation of America,* Camden, N. J.

HARDWARE RACK

Of interest to the radio serviceman is a new item which has been put on the market by *O-B Electronic Laboratories* of Glendale, California.

Known as the "ADA-RACK," this unit consists of 100 each of the ten most commonly used nuts and screws



handily attached to a rack which itself may be used as an additional shelf. This feature, combined with the fact that the rack may be attached to the wall, contributes to bench neatness and easy availability of the desired hardware.

Information on this line may be secured by writing *O-B Electronic Laboratories,* Box 1137, Glendale 5, California.

—30—

MAKE YOUR OWN QSL CARDS

THE QSL card shown below is that of Auburn Esslinger, W8OZP in Owosso, Michigan. Mr. Esslinger operates mostly on the 75 meter phone band and his card is of particular interest because, by means of pictures, he has told a complete story of his country, state, city, home, operating table and himself, XYL and other points of interest which are used to make up the call letters.

Since others of our readers might wish to adopt Mr. Esslinger's technique in preparing their own distinctive QSL cards, the methods used are outlined briefly. The original card measured approximately 20 x 30 inches and was as white a cardboard as it was possible to obtain. This size was chosen because it was easier to take standard size negatives and enlarge them to a size that would make them proportional to the layout. Incidentally, the layout was drawn in very lightly in pencil on the cardboard first.

While the pictures used for this particular card were 3¼ x 4¼ inches and were taken with a Speed Graphic, other sized prints taken with any good camera are equally suitable. The choice of pictures and the actual design of the card are left up to the individual as there are many different ways that this material can be presented.

In printing the pictures for the card it is important that the correct grade or contrast of paper be used to keep all pictures on the same scale as far as the blacks, whites and greys are concerned. The pictures were fastened to the card with rubber cement as ordinary paste or mucilage causes the pictures to wrinkle or buckle.

All of the lettering was done with India ink. The pictures were all printed on glossy paper (single weight) as it was found in a previous attempt that this type of print made the best copy, as a dull finished paper usually shows up the grain of the paper. Single weight paper was chosen as it adhered to the surface of the card better than double weight paper.

The entire card was then photographed to give a postcard size negative which can be printed on double stock with a postcard back. Of course for those amateurs whose equipment or talents do not run along photographic lines, the entire job of printing pictures and photographing the completed card can be entrusted to a professional photographer.

Mr. Esslinger expressed a willingness to discuss further details of his card on the air or by mail. Inquiries should be addressed to him at 721 E. Oliver Street, Owosso, Michigan. —30—

"Personalized" QSL card which tells a story about Mr. Esslinger's home and hobbies.

Depreciation and your Income Tax

By HAROLD J. ASHE
Tax Counselor

Income Tax is a costly item. Save, by following the tips presented by this noted income tax counselor.

CONSIDERABLE confusion still exists in the minds of many businessmen as to how to treat depreciation in their income tax returns. Not a few are still ignoring depreciation entirely on certain depreciable assets, with the result that their taxes are greatly increased. Many others have set up or are continuing to set up depreciation schedules which do not conform to the rules laid down by the Internal Revenue Bureau. In the latter instances, such tables of depreciation are frequently challenged at later dates by bureau auditors.

One commonly held misconception is that if depreciation is not taken from the outset of acquisition of a depreciable asset, the taxpayer may not start taking such depreciation at a later time. He may take such depreciation in a current return, even though he has overlooked it in previous returns. However, the depreciation, contrary to another misconception, does not start as of the date he first takes depreciation, but starts as of the date the asset is acquired. That is, past "allowable" depreciation is gone, even though not previously taken. Third error is that taxpayers who have not previously taken depreciation, even though it was "allowable" in past income tax returns, ignore "date of acquisition" and "cost or other basis," misconstruing "other basis" as an invitation to value such assets at what their present new replacement value would be, a figure usually higher than the actual asset cost at time of acquisition.

As relates to Federal income taxes, depreciation is an allowance for exhaustion, wear and tear of property used in a trade or business, or of property held for the production of income. The purpose underlying allowance for depreciation is to permit the taxpayer to recover over the useful life of the property the capital sum invested therein. The terms "used in trade or business" or "held for the production of income" would include property held for such purposes, though actually not in use during the taxable year.

Taxpayers should not confuse fluctuation in value of an asset with depreciation. For example, a piece of equipment becomes second-hand at the moment it is first used and at least its resale value may drop appreciably at that point. However, such a circumstance has no direct bearing on depreciation. Only that part of the loss in value which is due to actual exhaustion, wear and tear in business use, during the year, may be deducted as depreciation.

Neither are "obsolescence" and "depreciation" synonymous. Obsolescence is the reduction in value resulting from changes in circumstances that make it desirable or imperative that the property be replaced before it has been worn out, such as newer machinery that is faster, better or more economical than the old machinery. Annual depreciation is the loss which takes place in the course of a year.

If it is clearly shown that, because of economic or other conditions, property must be abandoned at a date prior to the end of its normal useful life, so that depreciation deductions alone are insufficient to return the cost or other basis, a reasonable deduction for obsolescence may be allowed in addition to depreciation.

"Complete exhaustion" does not necesarily mean the same thing as "useful life." If a piece of equipment, for instance, has a salvage or scrap value at the end of its useful life, this value must be taken into consideration in determining the depreciation rate.

A further requirement in determining depreciation is that the property must have a limited and determinable useful life in the trade or business. Land, for instance, upon which a building is erected, is not depreciable since it has no determinable life, and in setting up depreciation on real estate, the cost or other basis for the land must be segregated from the cost or other basis for the building. Thus, a building and land might represent an original cost at time of acquisition of $20,000. If, however, a fair value for the land at time of acquisition was $5,000, then the building's value at time of acquisition would be $15,000, and the depreciation schedule would be based on the $15,000 figure.

The length of useful life of a property is often difficult to determine. It depends upon particular circumstances, including the character of the property and its use. A well-built brick building may have a useful life of 50 years, and a frame building 25 years, a piece of machinery 5 or 10 years, a

UNIVIBE... *The Universal Vibrator!*

8 TYPES SERVICE OVER 2500 AUTO RADIOS

N. U. AUTO RADIO VIBRATORS ARE BUILT FOR ENDURANCE!

1. Welded pole pieces for lifetime adjustment accuracy.

2. Snug fitting synthetic sponge insulation for quiet operation.

3. Spot-welding of fingers, in contact against each other and the center reed, reduces voltage drop in center reed assembly.

4. Vibration proof adjustment by means of double-screw stack.

5. Pressure plate on top of stack keeps stack tight under tension over wide ranges of temperature.

6. Extra flexible roped wire leads eliminate strain and weakening.

7. Metal can, spun at bottom, seals vibrator against dust and dirt.

8. Plated pins assure minimum contact resistance.

9. Face of center reed weight is surface-ground to improve magnetic coupling.

10. Center reed uniformly stressed to prevent breakage.

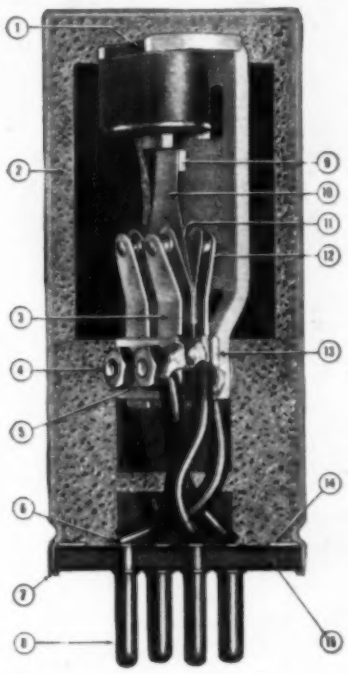
11. Specially tempered reed and side contact arms.

12. Corrosion resistant silver-plated side contact arms.

13. Precision ground bakelite spacers for structural and dimensional stability.

14. Steel ring, molded into shock mount, centers and holds vibrator upright when can is sealed.

15. Neoprene wafer in hermetically sealed vibrators effectively seals vibrator against atmospheric pressure changes and moisture.



Typical Synchronous Vibrator Construction

NEW LINE COVERS 97% OF ALL VIBRATOR REPLACEMENTS

UNIVIBE—the complete 8-model vibrator line—covers the replacement needs of over 2500 auto radio models! Provides quick, easy replacement of worn out vibrators in 182 makes of auto radios, as old as 1936!

Think of it—97% service coverage with only 8 fast-moving numbers—every one a repeat profit producer!

Yes, Univibe is right at the top in quality. Well known "balanced resonance" design, of extra heavy duty construction, means *33% longer vibrator life by actual test.*

Here is another money-making radio parts line for National Union dealers.

For immediate delivery order Univibes today from your N. U. Distributor.

NATIONAL UNION RADIO CORPORATION, NEWARK 2, N.J.

NATIONAL UNION RADIOS, TUBES AND PARTS

Receiving Tubes • Transmitting Tubes • Special Purpose Tubes • Cathode Ray Tubes • Radio Sets • Phototubes
Panel Lamps • Flashlight Bulbs • Ballasts • Volume Controls • Condensers • Batteries • Auto Vibrators

Build a Television

To stimulate its radio and television training programs, this famous resident radio and television school is offering men interested in television this unusual opportunity.

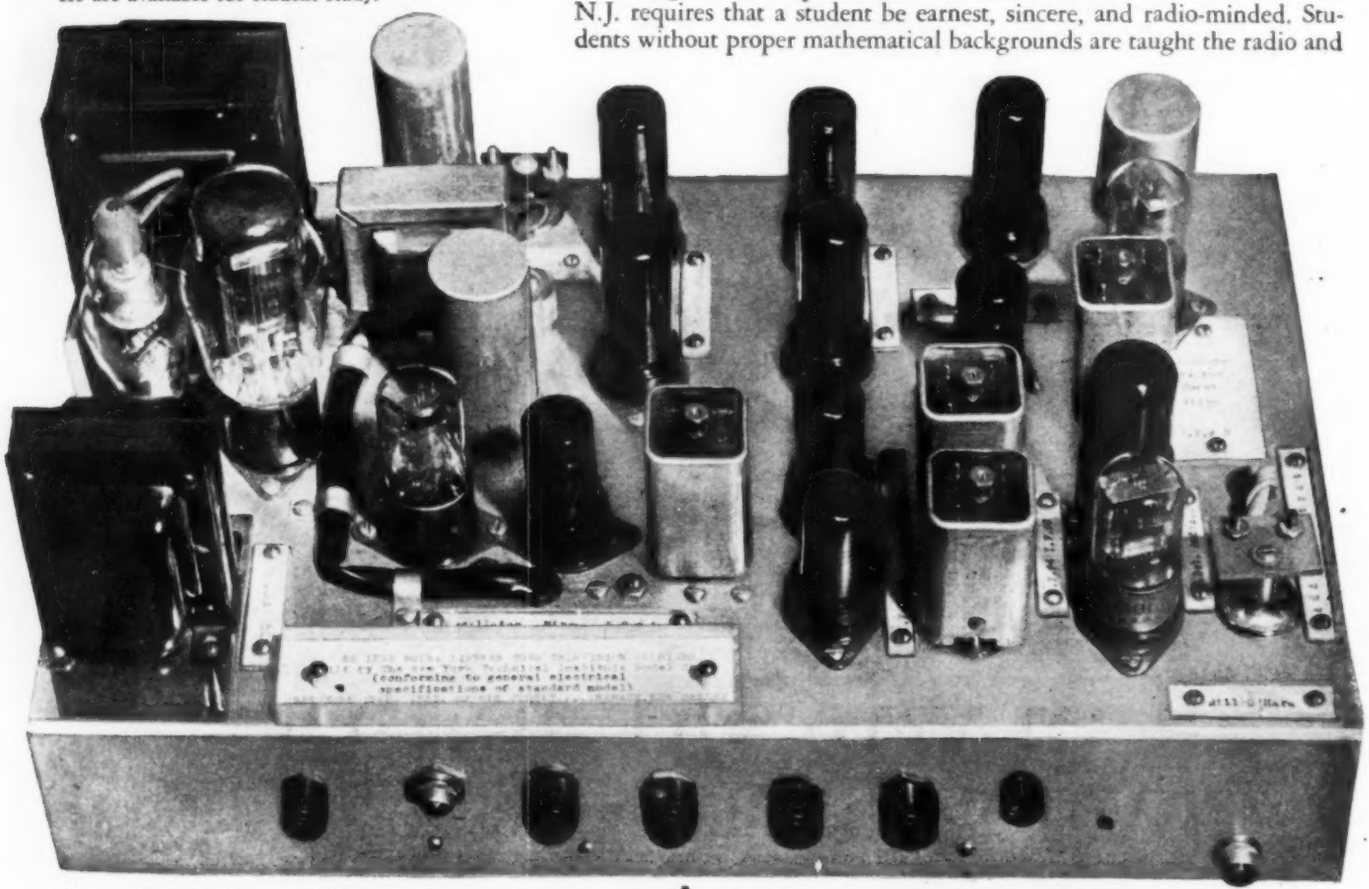
Instructor demonstrating rare Schmitt Optical System, used in big picture, projection type, television receivers. This famous television school's location in the heart of the television industry, helps it to get such scarce scientific equipment. At N.Y.T.I. of N.J. all types of television receivers are available for student study.

IF you are unable to leave home to go to a resident school, N.Y.T.I. of N.J. can supply you with parts to build a television chassis in your own home. You will be supplied with the same instructions and directions with which the school's resident students are equipped, when they reach the stage in their training that calls for television set construction. If you already have a sound radio background, with experience in building radio receivers, you will be surprised to find how much you can learn about television by building this set.

N.Y.T.I. of N.J. is one of America's leading resident schools for men seeking dependable, thorough, up-to-the-minute training in the various fields of radio and television.

The schooling offered by N.Y.T.I. of N.J. is particularly useful to those who recognize the high-earning possibilities of technical training in radio and television and are willing to tackle the class and laboratory work offered, regardless of their previous education.

No high-school diplomas are needed for entrance. But N.Y.T.I. of N.J. requires that a student be earnest, sincere, and radio-minded. Students without proper mathematical backgrounds are taught the radio and



You can build a direct viewing television chassis similar to the one pictured above, either in your own home or in the magnificently equipped shops and laboratories of this famous television school, located square in the HEART of America's television manufacturing and broadcasting industry. Mail the coupon at the right to get full details.

Set Right in Your Own Home!

television mathematics they need. Several students with only grammar school educations have successfully completed advanced technical television courses.

A considerable number of out-of-state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else in the world today. Living quarters are obtainable by single students.

You Put Into Practice Everything You Learn

Students at N.Y.T.I. of N.J. particularly like the way the school puts into practice what it teaches. You may actually build a 17-tube television chassis. You also help build as many as 7 radio receivers of different types, a total of 75 electronic educational devices. Class study, and laboratory study, in the proper combination, increase interest—and your hands get as smart as your head.

A 17-tube, experimental, television chassis may be built by all resident students of television, and may be kept as their own property, if they so choose.

Located in the Heart of the Electronic Industry

The New York Technical Institute of New Jersey is in Newark, N. J., just across the river from New York City (only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and electronics industry. Such leading television, radio and electronics manufacturers as R.C.A., Western Electric, Du Mont, Federal and Edison are nearby. This means that the school offers numerous advantages, as it is in touch with the most recent developments in radio and television.

Highly qualified television and radio instructors are here in abundance. Equipment is easier to get. Television students are offered exceptional advantages in this great electronic center.

MAIL THE COUPON TO GET FULL INFORMATION . . . FREE

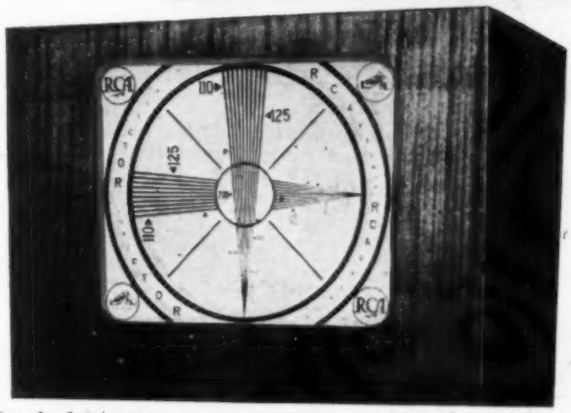
The school issues a special Bulletin which illustrates and describes its truly exceptional facilities and equipment. This Bulletin also describes classes that may be attended, housing conditions, costs, hours, etc. If you are interested in Television—you will want to read this Bulletin. You can have it *free,* merely by mailing the coupon at right.

The school will also be happy to send you complete information about the television kits and directions which are now available to you if you desire to build your own television chassis at home.

Just fill out the coupon at right and mail it NOW to: *New York Technical Institute of New Jersey, Dept. 11, 158 Market Street, Newark, N. J.*

Instructor demonstrating theory of light in connection with study of optical systems used in projection type television receivers. This is just another one of the pieces of equipment which the New York Technical Institute of N.J. has available for resident student instruction.

Big picture television (16" x 21¼") in the flesh at N.Y.T.I. of N.J. When it comes to television receivers, N.Y.T.I. of N.J. has it! All types of television receivers are available for student use and instruction at the school.



Standard laboratory type test pattern used for determining picture perfection in all types of television transmitters and receivers. (You can see it at N.Y.T.I. of N.J.)

New York Technical Institute of New Jersey, Dept. 11,
158 Market Street, Newark, New Jersey

☐ Check here if you wish to receive the Special FREE Bulletin describing the resident school of the New York Technical Institute of New Jersey located in Newark, N. J.—including its facilities, equipment, courses offered, costs, hours, etc.

☐ Check here if you wish complete information about building a television chassis in your own home.

☐ Check here if you are a War Veteran.

Name..... *Age*.....

Address.....

City..... *Zone (if any)*..... *State*.....

truck 3 to 5 or even 8 years, but in a particular business the useful life may vary considerably.

Alterations made by the taxpayer to business quarters which he rents for his business use may be depreciated over the period his lease has to run from the time such alterations were made.

Cars used partly in business and partly for private use may be depreciated, with that part of such depreciation chargeable to business use deductible, the personal part not being deductible, either as a business expense, or as a personal deduction.

In depreciation deductions, the amount claimed must be supported by data called for in depreciation schedules. Taxpayers may not safely, as many now do, merely show the amount of depreciation being taken without showing how they arrived at such annual depreciation. This information must include: the kind of property being depreciated, the date acquired, the cost or other basis used in computing depreciation, the depreciated value at the end of the year, the deprciation allowed or allowable in prior years (even though not previously taken), and the remaining cost or other basis to be recovered, as well as the estimated life used in accumulating depreciation, and the estimated remaining life at the beginning of the tax year being reported.

Any recognized method of accounting practice may be used in computing depreciation, provided the method is used consistently. Once the method is elected it may not be changed except with the permission of the Commissioner of Internal Revenue. Nor may depreciation for one year be taken in another year. Each year's depreciation must stand by itself, and be taken in the year in which such depreciation occurs.

-30-

U.H.F. Oscillator

(*Continued from page* 35)

are no difficult adjustments to be made.

With the condenser soldered across the end of the line, the frequency of oscillation will be about 400 megacycles. When the condenser is soldered directly at the plate and grid terminals at the tube socket, oscillation frequency will be 800 megacycles.

This little gadget is a suitable foundation unit which can be used as the r.f. section of a superregenerative transceiver or simple low powered transmitter. A small modulator of 2 watts ouput will provide satisfactory phone operation.

Fig. 3 shows how an antenna may be coupled to this oscillator. Coupling may be adjusted by varying the position of the loop and adjusting the screw for capacity variation.

With an oscillator operating at this frequency there is not a great deal of difference in the loaded and unloaded condition.

-30-

SENSITIVE CRYSTAL VOLTMETER

THE Sylvania type 1N34 crystal diode with a 0-1 d. c. milliammeter makes a sensitive voltmeter for a. c. and r. f. values below 1 volt. The simple circuit diagram of the instrument is given in Fig. 1. A meter of this type is invaluable for fractional voltage measurements in the communications laboratory and for use as an indicator across tuned circuits, in wavemeters, in weak-signal a. f. or r. f. bridges, in conjunction with exploring probes, in field strength meters, modulation meters, etc.—wherever no d. c. component is present and where the relatively low impedance of the diode and meter combination can be tolerated.

The calibration curve appears in Fig. 2. An almost imperceptible vibration of the milliammeter pointer was noticed at 60 cycles and apparently was due to the small back conduction of the crystal diode, but it did not appear to affect the accuracy of the calibration. Experimentation proved that it could not be eliminated by using a larger meter bypass capacitor than the one shown in Fig. 1.

The voltmeter may be calibrated against some other reliable a. c. voltmeter (v. t. voltmeter or 1000- to 20,000-ohms-per-volt-meter) by means of a source of variable a. c. voltage (0-1, or 0-2 volts r. m. s.), such as the output of a 2½ volt filament transformer taken through a 10,000-ohm potentiometer. For approximate results, the curve given in Fig. 2 may be used in lieu of an individual calibration.

-30-

Fig. 1.

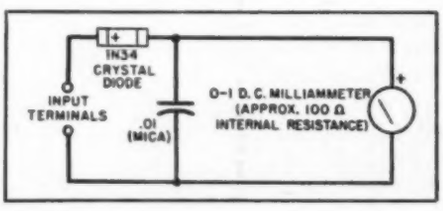
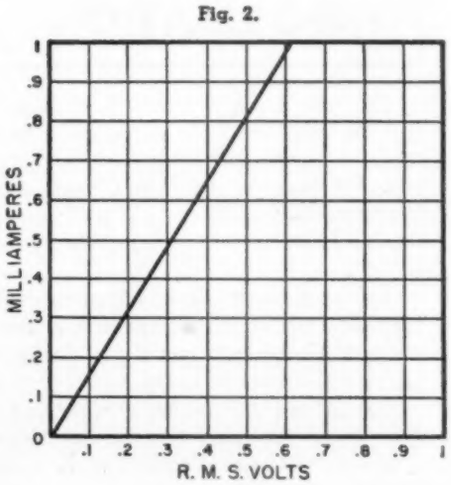


Fig. 2.



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Find radio faults quickly. Make the needed repairs in any radio in minutes instead of hours. Save time on every job. This large, inexpensive diagram manual has the circuit for every popular 1946 radio set made since V-J day. Large manual, 8¼x11 inches, 192 pages. Just out. Price postpaid, only..... **$2.00**

1942

Clearly printed circuits, alignment data, parts lists, service hints are the facts you need to speed up radio servicing. Repair radios quickly and properly—follow the factory instructions given in these manuals. 1942 Manual has 351 models of 40 largest manufacturers. 192 fact packed pages. Large size, 8½x11 in. Manual style binding. Order manuals you need today..... **$2.00**

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Most Popular Models Made By:

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Let this important manual give you over 80% of all 1940 circuits you will ever need, acquaint you with new developments, train you to service quickly and efficiently millions of sets. Data on F.M., portables, recording, etc. 417 models of 43 manufacturers. 208 large pages of helpful data **$2.00**

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Another handy manual of most-popular diagrams you need. Circuit data, hints and information are time-savers and money-makers for you. Let these diagram manuals guide you to easier service work. Why try to get along without helpful diagrams? Use this volume with 192 pages of diagrams of 39 makes. Order these manuals today. The 1939 Manual is priced at only..... **$2.00**

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Learn new speed-tricks of radio fault finding, case histories of common troubles, servicing short-cuts, extra profit ideas. Many large lessons on the use of regular test equipment, explanation of signal tracing, television to the minute, recording dope. Many active servicemen used this reduced price radio training for brush-up and study of new service methods. Reprinted in 1945 with new information on signal-tracing, television, visual alignment, P.A., photocells, and every other fact you must know to be more expert in your work. Complete, 22 lessons, size 8½x11 in. With self-testing questions. Great bargain in home-study radio training. Postpaid, only..... **$2.50**

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Introduces and explains the use of arithmetic and elementary algebra in connection with units, color code, meter scales, Ohm's Law, alternating currents, ohmmeter testing, wattage rating, series and parallel connections, capacity, inductance, mixed circuits, vacuum tubes, graphs, curves, the decibel, etc., etc., and has numerous examples. Low price, only..... **25c**

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☐ 1946 ☐ 1942 ☐ 1941 ☐ 1940 ☐ 1939 ☐ 1926-38
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☐ Send C.O.D. I am enclosing $..... deposit.

Name: .....

Address: .....

Ring Oscillators

(*Continued from page* 50)

would be possible with only one or two triodes of the same type.

Lastly, this circular arangement also permits, when desired, the use of u.h.f. triodes which are physically large.

For the foregoing reasons of stability, greater output power, higher operating frequency, and use of larger vacuum tubes—it is evident that these important advantages can be increased in magnitude *by the addition of more and more pairs* of triodes to the basic 4-tube ring oscillator.

Large Ring Oscillators

Any even number of u.h.f. triodes of the same type may be connected in this series-circular arrangement, known as a ring oscillator.

All of the previous circuit conditions for sustaining oscillations will apply to such multi-tube oscillators.

Leads between plates and grids of adjacent tubes connect to quarter-wave resonant lines, each of which is tuned to resonance by a shorting bar.

Oscillations take place because of *unbalance* due to standing waves on the Lecher lines, inherent *inductive effects* of the circular system, and *feedback* through the interelectrode capacitance of all tubes.

Use of a large number of pairs of triodes does not alter the fundamental circuit operation.

Output power of a ring oscillator increases almost linearly with the addition of each pair of tubes; a transmitter with 16 tubes having an output power of approximately 8 times that of a pair of the same type of triodes in a push-pull resonant-line circuit.

Maximum high-frequency limit of operation in the u.h.f. band is extended by the addition of each pair of triodes in a ring oscillator. This extension is somewhat logarithmic, but varies in degree according to the type and frequency characteristics of the u.h.f. triodes used in the circular circuit.

A typical ring oscillator, consisting of 24 triodes of the same type, is shown in Fig. 4.

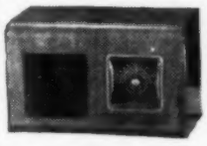
Quarter-wave sections of resonant lines are used to tune the plate and grid circuits of every tube. Grid tank circuits are connected together by a *grid ring* — which is biased to r.f. ground. All plate tank circuits are also connected together by a *plate ring*. Plate voltage is applied through this output ring to all of the u.h.f. triodes.

Cathodes or filaments of the oscillating tubes should be operated at r.f. ground potential. At ultra-high frequencies of operation, bypass condensers would not effectively ground the filaments because of high reactance in the filament leads. For this reason, a half-wave section of transmission line—either resonant line, or

McGEE'S BARGAIN PAGE

1947 — COMPLETE RADIO KITS

SENSATIONAL PEE WEE AC-DC KIT Model K-PW. Size 6½x5x3½ inches. Very small in size; uses pee wee tubes 1R5, 1T4, 1S5 and 3S4 and new dry disc rectifier. Conventional superhet circuit with AVC; 2 gang condenser. Receives broadcast 550 to 1700 KC. This set when wired according to our diagram will make a hot little personal radio. This kit is priced complete; just as all our kits are, with tubes, cabinet and speaker; nothing else to buy.....Net **$11.95**



5-TUBE AC RADIO KIT superhet circuit using new permeability tuning unit. Covers broadcast 550 to 1700 KC. Beautiful walnut cabinet 12x7x6 5" A5 PM speaker. Everything complete, includes 6SA7, 6SK7, 6SQ7, 6K6 and 5Y3 and diagram Model K-5A. Net **$16.95**

KIT K-7A 7 tube AC superhet 550 to 1700 KC. Has push-pull audio stage with tone control and 6½ in. alnico 5 PM speaker. Conventional circuit with AVC. Similar in appearance to model K-5A except has slightly larger cabinet. Everything complete including diagram and tubes 6SA7, 6SK7, 6H6, 6SN7, 2—6Q6, 5Y3. A real value.....Net **$19.95**

5-TUBE AC DC KIT. Superhet using permeability tuning. Covers broadcast 550 to 1700 KC. Walnut cab. 6x7x9. Everything complete including tubes 12SA7, 12SK7, 12SQ7, 35Z5, 50L6 and PM speaker and diagram Kit K-5. Net **$12.95**

KIT K-5B farm radio superhet kit in same cabinet as model K-5. Uses permeability tuning rec. broadcast 550 to 1700 KC Everything complete with 5" PM alnico 5 speaker and 1R5, 1S5, 1T4, 3S4 tubes, diagram less Batt. Net **$10.95**

DELUXE AC-DC KIT J-D5 Beautiful walnut cabinet and all the parts to build a broadcast 5 tube AC-DC radio. Superhet with slide rule dial, 2 gang tuning condenser and loop aerial. Everything furnished; includes speaker and tubes 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6 and diagram. Kit J-D5. Net **$14.95**

OUR LEADER KIT $9.95. AC-DC 4 tube TRF kit 550 to 1600 KC Kit K-4It, a TRF job with a walnut cabinet and 5" alnico 5 PM speaker. All parts furnished; including tubes and diagram. Has direct drive dial and a very simple standard circuit. An ideal kit for the student or experimenter. Just a few hundred to sell.....Very Special at only **$9.95**

MINIATURE POCKET VOLT OHM METERS. D'Arsonval type meter. Best values you have seen in vom. ONLY 4x2⅞x2" Bakelite panels, all metal cases.
Model 450A has 1000 OHMs per volt sensitivity.....Net **$9.75**
Volts DC 0-5/10/50/500/1000. Milliamperes DC 0-1. OHMS FULL SCALE 5000/50,000/500,000. OHMS CENTER SCALE 30/300/3000. Model 451B 2500 ohms per volt sensitivity. Has AC ranges.....Net **$15.15**
VOLTS DC 0-10/50/100/500/1000. VOLTS AC AND OUTPUT 0-10/50/100/500/1000. OHMS FULL SCALE 500,000. OHMS CENTER SCALE 7200. Model 452A has 10,000 ohms per volt sensitivity....Net **$13.65**
VOLTS DC 0-10/50/100/500/1000. OHMS FULL SCALE 2000/20,000/200,000/2,000,000. OHMS CENTER SCALE 30/300/3000/30,000.

FLUORESCENT BED LAMP. 110 Volt AC. All Plastic construction. Complete with 8 watt lamp. Offered in walnut or Ivory. Dealers.....Net **$5.40**
Power supply to convert 1½-90 volt or 2-90 volt farm and portable radio to 110 volt AC operation. Easily wired to set. Completely wired and tested; with tube and instructions. J-P2. Dealers.....Net **$5.95**
2 Gang condenser, oscillator coil and loop; all matched. Special **$1.95**
2 Gang condenser, ⅜" shaft, cut back section. Special **$1.49**
456 K.C. First and Second high gain I. F. Trans. Special .....Each **.49**
3 or 4 wire 456 oscillator coils..... **.24**
Small loop antennas..... **.39**
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Delco off set 4 prong 6 volt	1.79
Mallory 5 prong sync. 6 volt	1.95
Oak stan. 6 prong sync. 6 volt	1.95
Utah SP-55 off set 5 prong sync. 6v	2.59
Utah Sp-62 reversible 6 prong sync.	2.59
Sync. unit only, long leads 6 volt	1.69
Utah SL-5 sync. unit with buffers	2.59
Midget Radiart 6 prong sync.	1.49
32 volt standard 4 prong	1.49
General Elec. 7 prong 2 volt sync.	1.95
Heavy duty 6 prong sync. for 30 watt 6 volt amplifiers. Special	2.95

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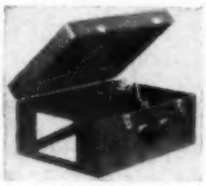
High Power Push-Pull Amps

You can save money by assembling your own record players. All the kits listed below are complete; nothing else to buy. In 15 or 20 minutes any of these kits will be ready to sell to your customers.
*The model JT-5 high power push-pull 3 tube AC-DC amplifier is furnished with all record player kits complete; wired and tested and furnished with tubes and speaker. The push-pull circuit assures good base response even at low volume. For servicing convenience and connecting to pick-up, a schematic diagram is furnished.

KIT J-15 SINGLE RECORD PLAYER. Attractive ready cut walnut finished cabinet with latest 78 RPM phono motor and light weight crystal pick-up and *JT-5 push-pull AC-DC amplifier and 4" alnico 5 PM speaker. This player will surprise you in appearance and performance.
Kit J-15 Dealers.....Net **$15.95** complete

KIT J-16 AUTOMATIC RECORD PLAYER. Beautiful walnut finished, made to fit cabinet; latest single post automatic record changer and *JT-5 high power push-pull AC-DC amplifier (wired and tested) and heavy duty 5" alnico 5 PM speaker. This kit makes a deluxe home record player.
Kit J-16 Dealers.....Net **$29.95** complete
KIT J-16A. Same as J-16 except with leatherette base instead of walnut. Dealers....Net **$26.95** complete

KIT J-17 PORTABLE SINGLE RECORD PLAYER. Attractive tan leatherette covered portable case with latest 78 RPM rim drive phono motor and light weight crystal pick-up and push-pull AC-DC amplifier *JT-5 (wired and tested) and 5" heavy duty alnico 5 PM speaker. A red hot special.
Kit J-17 Dealers.....
..Net **$19.95** complete



KIT J-18 PORTABLE AUTOMATIC RECORD PLAYER. Beautiful portable leatherette case and latest single post automatic record changer and *JT-5 3 tube AC-DC push-pull amplifier (wired and tested) and heavy duty 6" alnico 5 PM speaker. We have sold hundreds of these to our dealers and they keep coming back for more. A real value. Kit J-18 Dealers.....Net **$33.95** complete

KIT J-19 SINGLE RECORD ATTACHMENT. Attractive walnut finished base with motor cut out, latest 78 RPM rim drive phono motor and light weight, high output crystal pick-up. Easily attached to any radio or amplifier.
Kit J-19 Dealers.....
...Net **$9.95** complete
Model B-4 phono oscillator (fits under base). Dealers .....Net **$3.69**

HOME RECORDER KIT J-K6.
Dealers.....Net **$59.95**
Consists of latest General Industries dual speed 33 or 78 RPM record-play-back mechanism. Beautifully made to fit walnut cabinet and a complete kit of parts to build a high quality recording amplifier with push-pull 6V6 outputs. All parts, tubes, 5" PM speaker, Astatic crystal mike and diagram furnished. This amplifier can also be used as a 15 watt PA system. Provisions made to connect 12" PM Speaker. (12" G. E. PM Speaker and wall baffle **$16.95** extra) Net Kit J-K6 **$59.95**

TWO-TUBE PHONO OSCILLATOR, $3.69

Complete, wired and tested. 800 to 1500 KC. Model B-4. Has audio gain stage for proper power output. Complete with tubes ready to operate. **$3.69.**
Mike Oscillator model C-4 is similar to model B-4 except has added gain stage for crystal mike. Complete with 3 tubes and fader control **$4.95.** Crystal mike **$4.90** extra.

ASTATIC CRYSTAL PICKUP WITH NEW NYLON NJI. Cartridge and replaceable Sapphire needle. Very Special **$5.95**

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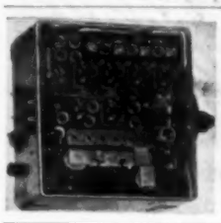
ANOTHER HOT WAR SURPLUS SCOOP.

ARMY BC-645 I.F.F. UNIT. Net $16.95. Early in the war, when radar picked up a plane, there was no way of knowing whether it was friendly or not. That was before BC-645 was invented. BC-645 sent out a signal that identified the plane as American. It probably saved more lives than any other piece of electronic equipment made. With some modifications the set can be used for 2-way communication, voice or code, on the following bands: ham band 420-450 mc., citizens radio 460-470 mc., fixed and mobile 450-460 mc., television experimental 470-500 mc. Equipment capable of doing the jobs of the modified set sells for hundreds and hundreds of dollars. The 15 tubes alone are worth more than the sale price. 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955 and 1-We316A. It now covers 460 to 490 mc. Each BC-645 is shipped with a Belmont factory printed conversion diagram, showing how to make AC power supply modulator and how to make Transmitter and Receiver changes. Most Hams and experimenters already have the few parts necessary. New BC-645 with tubes less power Supply.....**$16.95**

SENSATIONAL SURPLUS BUY.

BC-654-A. Transmitter-Receiver 12 watts CW, 8 watts phone. 3800 to 5800 KC $19.95. Used but in apparently good order. Offered with 3-307A tubes but less receiver tubes. The 7 tube superhet receiver has 2 RF stages. Designed for 1½ volt octal tubes. Could be converted to heater tubes. Has built in 200 KC crystal callibrator. The 200 KC crystal and 0-3 RF thermocouple ammeter and 3-30°A tubes are worth the price we are asking for the whole unit. First come first served. BC-654-A transmitter-receiver less power supply .....Net **$19.95**

WAR SURPLUS NEW SCR-522. 100-156 MC Transmitter-Receiver. 4 Crystal controlled channels. 8 watt output on phones. Complete with 18 tubes, 2-832, 3-12A6, 1-6G6, 2-6S87, 1-12J5, 1-12C8, 1-9002, 3-9003, 1-12AH7 and 3-12SG7. New SCR-522 shipped with tubes, and 28 volt MG set. Simple conversion changes necessary are covered in October and November '46 issues of Radio News. This is a real value. SCR-522 .....Net **$66.95**



FM MOBILE ARMY TRANSCEIVER
2 channels 35 to 42 MC. 19 miniature 1⅘ volt tubes and 6 spares. Vibrator power supply for either 6 or 12 volt DC. Less crystals and top and bottom plate. Special $24.95. Speaker $4.95. Telephone hand set **$4.95**

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1L4 and adapter to 1LE3	$0.99
1T4 and adapter to 1LN5	.99
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These adapters work right and save you real money.

ADAPTERS AND TUBES
for less than price of tubes in regular 1½ volt series

1R5 and adapter to 1A7	$0.69
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40 MIL STANCOR POWER TRANSFORMER
Flush mounting 6.3, 5 volts. Special.....**$1.98**

12" G. E. SPEAKER
7 oz. Alnico 5. Beats anything you ever heard.
List $16.50.....Net **$9.50**

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7 oz. Alnico 5.
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SCOOP ON ALNICO
5 PM Speakers.

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5" 1 oz.	1.59
5" 1½ oz.	1.69
6" 1½ oz. square	1.95
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8" 8 oz. Alnico 3	2.95

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MASCO MC 25 P 110. 6 volt Combination Amplifier with turntable top is back in stock. Ideal for outdoor work. 1947 model. Complete with tubes, Amplifier only **$98.00**
ASTATIC DYNAMIC MIKE made for Uncle. Long deep throat design. Gray wrinkle and chrome 20 ft. cord; swivel head. Ideal for all around P A work. List $25.00. Special.....**$10.95**

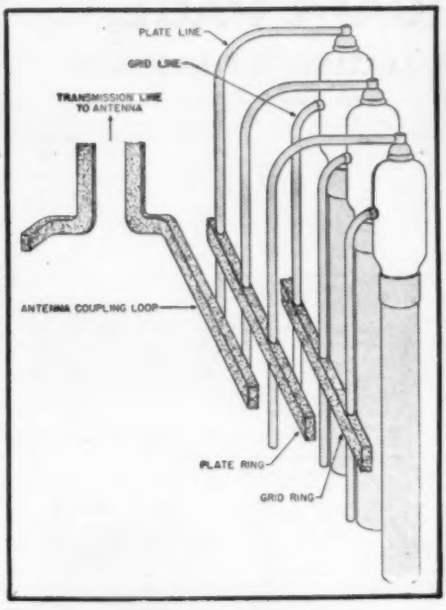

Fig. 5. Method of coupling employed in ring oscillator.

coaxial cable—is connected to each filament. The far end is shorted to ground, and transformer action of the half-wave line make this r.f. ground appear at the filament of the triode.

Since the plate ring is circular in nature, output power is coupled from it by means of a single-loop induction coil placed in the same plane as the plate ring.

The method of coupling and physical arrangement of components can be better understood by reference to Fig. 5, showing a portion of the construction of a typical ring oscillator.

Physical arrangement of the oscillator places all of the triodes in a circle, equidistant from one another. Plate tank circuits of each pair of triodes are constructed on the *inside* of the tube circle. If possible, the grid tank circuits should also be on the inside of the circle. The half-wave Lecher or coaxial lines used to tune the cathodes or filaments are generally enclosed in metal cylinders, and each triode is mounted directly atop its respective resonant line.

In the interest of space economy, grid and plate tank circuits are also mounted vertically. This arrangement places all of the shorting bars on approximately the same horizontal planes in somewhat of a circle, with the shorting bars of the plate circuits on a different plane and separated from the grid-circuit shorting bars. This separation should be more than one-half wavelength to prevent coupling between the two circuits.

In all the plate tank circuits current is maximum in the shorting bars, and flows in the same relative direction. Thus, the bars can be physically and electrically connected together. One arrangement (Fig. 5) connects all of the shorting bars together to form a continuous, circular metal ring. This plate ring shorts every plate tank circuit of the oscillator, and provides a single loop of current.

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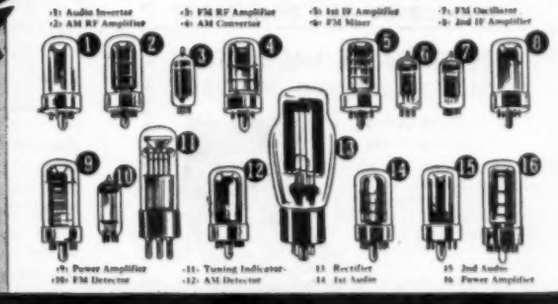

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RADIO MANUFACTURERS *Since 1920*

Individual tank circuits can be tuned, as before, by adjusting the position of this plate ring or circular shorting bar.

A single-turn loop or coil placed in the same plane *and within* the circular plate ring will receive u.h.f. energy oscillations by inductive coupling. Coupling to the pickup loop is due to magnetic fields produced by currents in the plate ring.

In a somewhat similar manner, individual shorting bars on each of the grid tank circuits may be replaced by a single, continuous, circular metal ring (Fig. 5).

The physical arrangement of a multi-tube ring oscillator is considerably simpler than the schematic circuit (Fig. 4) would indicate. Despite its simplicity of construction, however, spacing and arrangement of all components of the oscillator are extremely critical of design.

The u.h.f. oscillator has only one disadvantage; it requires a large number of tuning adjustments. Grid rings, plate rings, and shorting bars in the filament circuits all require deft tuning at the resonant frequency of the transmitter. If adjustments are not made properly, considerable inefficiency will result.

However, this single disadvantage is offset by the symmetry of physical construction. Equispaced circuit elements and circular arrangement permit ganging of many tuning controls. For most types of the newer u.h.f. triodes, critical circuit adjustments are not necessary to sustain oscillations.

—30—

Antenna of Raytheon's Mariners Pathfinder radar test installation which was recently installed aboard the Atlantic Refining Company's "SS Atlantic Mariner." This installation marks the first time ocean going American commercial tankers have been equipped with radar. The first run covered the Atlantic water route from Corpus Christi to Fort Mifflin. According to Captain Preston I. Williamson, ship's master, radar "took over" when a flashing buoy off Cape Hatteras failed to operate in marking position of a wreck.

How to Avoid Saving Money

by DANNY KAYE

To avoid saving money, the first thing is to cut off all your pockets. (Or throw away your purse and keep your lipstick in your snood.) Thus you will have to carry your money in your hand. Which will insure that you—1. spend it, 2. lose it, 3. get it taken from you—*quicker!*

Also to be avoided like crazy are piggy banks and sugar bowls. Keep these out of your home! The kiddies in particular are victimized by such devices, often saving quite a bale of moolah. Be stern even if the little ones cry—remember what money could do for them! And be sure to avoid budgets. It is best to draw your pay and walk down Main Street buying anything you don't particularly hate.

Above all, don't buy any U. S. Savings Bonds—or it's *impossible* not to save money! These gilt-edged documents pay fat interest—4 dollars for 3 after only 10 years! There is even an insidiously easy scheme called the Payroll Savings Plan by which you buy bonds *automatically*. Before you catch on, you have closets full of bonds. You may even find yourself embarrassed by a regular income! Get-gat-gittle!

Danny Kaye

SAVE THE EASY WAY...

BUY YOUR BONDS THROUGH PAYROLL SAVINGS

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.

International Short-Wave

(*Continued from page* 60)

"The complainants appear to have overlooked the revised allocations of frequencies made at Cairo in 1939. Under the Madrid regulations of 1932, the whole band from 7000 kcs. to 7300 kcs. was reserved exclusively for amateur use, but under the Cairo Conference regulations, which became effective on Septmber 1, 1939, the band from 7200-7300 kcs. was shared between amateurs and broadcasting.

"While, therefore, the BBC is justified in using these frequencies for its broadcasting services, it naturally does not wish to interfere with the activities of amateurs, and will always seek to avoid such interference by choosing frequencies in other broadcasting bands when these are suitable and available.

"As solar activity is now increasing, the BBC expects to be able to maintain its services to the Americas during the next few years without recourse to the 41-meter band, thus reducing to a minimum interference with amateur activity." (*London Calling*)

* * *

News of the Clubs

AUSTRALIA—I have just received a copy of *"Skyrider,"* a publication devoted to the progress in DX, published by the *Australian DX Radio Club* with headquarters in Melbourne, Victoria. Gives present club officers as J. Hutchison, president; E. McGrath, vice-president; A. Canty, secretary; editors are E. Tinning, broadcast, C. R. Skoglund, short-wave and E. J. Miller, amateur. All correspondence regarding short-wave activities should be addressed to Mr. Skoglund at 32 McConchie Avenue, Kew, Melbourne, Victoria, Australia.

DENMARK—From Lund Johansen, Editor, *Populaer Radio,* Pilestraede 35, Copenhagen, comes word that the *Danish Short Wave Club* has recently been organized in that country. "I would be pleased to hear from DXers in any part of the world," Mr. Johansen writes. He sends out a monitor's card and offers Danish and other Scandinavian stamps to those sending in reports for use in *Populaer Radio* and the Danish short-wave bulletin, *"Shortwave-Listener."* Members of the new Danish club are seeking "pen pals" throughout the world. Further details can be had by writing to Mr. Johansen at the address given above.

ENGLAND—Sponsored by *Short Wave News,* the *International Short Wave League* has been formed in Britain. According to information just over from England, "The ISWL will cater for every class of short-wave enthusiast, be he constructor, listener, or transmitter. Entry into the ISWL is not hampered by any unnecessary restrictions, and there will be no varying classes of membership. For the present, membership fees are purely

nominal and are intended simply to cover cost of certificates, postage, address plates, and so forth. Membership identification numbers will consist of the letters 'ISWL,' followed by the prefix for locality coupled to an individual number, e.g., ISWL/VK234 would indicate a member in Australia. Until such a time as the membership justifies the publication of a separate League journal, news of the League will be carried in the pages of *Short Wave News." The First Annual* has been prepared and should be out by this time; it is described as containing "a wealth of information for the DX listener" and as "the only book of the type and accuracy available" in Britain at this time. Arthur C. Gee (G2UK) is editor of *Short Wave News,* and W. Norman Stevens (G3AKA) is assistant editor.

Objectives of this new ISWL are described as: "To bring together the short-wave enthusiasts of the world, regardless of race, creed, or politics, to their mutual benefit. To foster and promote international goodwill through the medium of short-wave radio interest. To provide facilities which will enable enthusiasts to carry out their hobby to the greatest advantage to themselves and their fellow enthusiasts."

All communications regarding the ISWL should be addressed to ISWL, 57, Maida Vale, Paddington, London, W. 9, England.

The present Council of the *International Short Wave Club,* 100, Adams Gardens Estate, London, S.E. 16, includes A. E. Bear, secretary, and joint trustee with T. E. Port; members, T. A. Lidstone, Bob Cowell (G3WX), and Wing Comdr. Kenneth Jowers. (ISWC)

NEW ZEALAND—*The New Zealand DX Club,* Inc., has chosen as officers for the coming year: President, Stuart G. Bennett, 7 Rautara St., Orakei, Auckland; vice-president, Chas. McMillan; secretary-treasurer, Hank J. Barr, 10 Koraha St., Remuera, Auckland, S.E. 2; members of the Executive Committee are Mrs. M. Bennett, Mac Allison, Ted Bacon, James Dawson, Arthur Gunn, and Bill Masson. Merv Branks, 5 Dublin St., Invercargill, Southland, is editor of *DX-TRA,* monthly bulletin of the club;

"It's an idea John picked up while he was stationed in India!"

RADIO NEWS

Arthur T. Cushen is the short-wave editor, and Keith Robinson, the BCB editor.

SWEDEN—From Halsingborg, Carl-Eric Petersson writes that DXers in that town have organized a new radio club, *Foreningen Nordvastra Skanes Radioamatorer.* The club has two sections, DX and "ham." President of the organization is Toge Paulson (SM7QE). The club has a monthly house organ called *"DX-News,"* of which Mr. Petersson is editor. The club will use both Swedish and *English* in its publication. Address is Luleagatan 14, Halsingborg, Sweden (Sverige).

* * *

Verifications

Stations operating from Switzerland are now verifying with an attractive card. It features a map of Europe, with Switzerland stressed in red. The country is aptly referred to as "the heart of Europe." The reverse side gives details of frequencies of the Schwarzenburg transmitters. Address for reports is Swiss Broadcasting Corporation, Neuengasse 30, Berne, Switzerland.

"Radio Maroc" verified by letter (in French) for an Australian DXer and gave address as "Radio Maroc," Resident Dengeral de Republique de France en Morocco, Rabat.

Per Friis, Denmark, lists recent veries as WCBN, WCBX, KWID, KCBR, WBOS, FZI, VLA3, SEAC (Ceylon), CKLX, ZLT7, XGOY, XORA, OTC. (Incidentally, Per, who is 17 years old, uses a 1941 Philips 3-tuber with only one short-wave band.)

Recent veries received by Glynn Moss, Ontario, are from *Radio Paris,* XEQQ, XEBT, OTC, and HJDE.

Verifications reported by Bill Milne, New Zealand, include BFN, SDB-2, KRHO, WRUS, WRUL, *Singapore Radio* (6.77 and 11.735), VLR, CKLO, and XGOY.

Jean-Marie Gauvreau, Quebec, reports a verie from COKG, 8.955, Santiago de Cuba, which sent a postcard in color and a mimeographed letter (in *English*). Address, La Cadena Oriental de Radio, Palacio del Radio, Estrada Palma No. 658, Apartado 82, Santiago de Cuba, Cuba. Mr. Gauvreau also reports HI2T, 6.480, Monsenor Nouel, Dominican Republic. Verifies with a nice postcard in blue, white, and orange; address, La Voz del Yuna, Monsenor Nouel, Dominican Republic-can.

Received by Mervyn Laubscher, Johannesburg, South Africa, are veries from CKNC, VLG4, XGOY, FZI, HEF4, *Radio SEAC* (Ceylon), PCJ, ZFY, Cable and Wireless, Ltd. (*Radio Athens*), and KZRH. Mr. Laubscher reports that *Radio SEAC,* G.P.O., Colombo, Ceylon, recently at 8:25 a.m. on a Sunday (heard by him on 15.120 but now on 11.77 at that hour), presented a talk by the Chief Engineer (probably a regular Sunday feature) in which it was stated that QSL cards are now being sent out. Incidentally, the verie letter received by Mr. Laubscher from *Radio SEAC* was a reply to his report on a test transmission on 9.520, heard June 7-8, 1946.

A verification card from TGWA, Guatemala City, Guatemala, lists frequencies as TGW, 640 kcs.; TGWA, 9.760 and 15.170; TGWB, 6.535; and TGWC, 1,520 kcs.; it was stated *these are frequencies TGWA is actually operating on.* (Cooley)

Late veries received by Ronald W. Gray, New Zealand, are from YV1RX, LRS, COBQ, CKLO, CXA19, CXA10.

* * *

This Month's Schedules

ALBANIA—ZAA, 7.852, Tirana, has *English* news at 4-4:15 p.m. (BSWL). This station is seldom heard in the United States; has bad QRM.

ANDORRA—*Radio Andorra,* on about 5.980 (varying), is sending a good signal most afternoons and early evenings; has *English* at 3:30 p.m. (Gauvreau).

AUSTRALIA—Recent changes effected by *Radio Australia,* as listed by August Balbi, Los Angeles, California, include VLG10, 11.76, 11-12 noon to West Coast and South Africa, replacing VLG, 9.58; VLB2, 9.68, heard 11:45 p.m.-12:45 a.m. to West Coast, replacing VLB8, 21.60; VLC4, 15.32, heard to 10 a.m. to Asia, replacing VLC6, 9.615, also heard to Britain, 10-11 a.m.

The evening beam to the Eastern U.S. and Canada is now heard beginning at 7:15 and closing at 8:30 p.m. over VLA9, 21.600, and VLC9, 17.840; *English* news is still read at 8 p.m. I note that both these stations now return at 9 p.m. with a "program for Australian Forces during the next two hours"; stations in the 25- and 19-meter bands, respectively, are announced as in parallel also; *news* is at 10 p.m.

East Coast DXers desirous of logging VLR2, 6.150, Melbourne, will find it a fair to good signal at 6 a.m. when news is given; others that can be logged, with *English news,* at that time include VLQ2, 7.215, Brisbane, weak, and VLW7, 9.520, Perth, excellent.

VLA4, 11.77, in the Forces' program, is usually a good signal in the East around 4:15-6:30 p.m.; announces VLC10, 21.680, VLB6, 15.200, as in parallel. (Ferguson, Beck)

VLR2, 6.150, appears to have lengthened its schedule recently; new sign-off is 9 a.m. (Dilg)

AUSTRIA—*Radioverkehr Actien Gesellschaft* stated in a letter to a Swedish reporter that they operate over KWS-1, 9.833, KWS-2, 12.212, KWS-3, 6.171, and KWS-4, 7.161, with power of 35, 2, 4, and 4 kws., respectively. The KWS prefix probably stands for *"Kurzwellen Sender."* (Gillett)

AZORES—*"Emissora Regional* Azores," 11.090, Ponta Delgada, is being heard well on East Coast, 3-4 p.m. (Harris)

BARBADOS—According to Charles Mohri, reporting from Rio Grande, Brazil, VPL6, 5.305, Radio Distribution, Ltd., on facilities of Cable and

Wireless, Ltd., Trinidad, broadcasts sports events and other items of public interest at certain times; no fixed schedule.

BELGIAN CONGO—A letter received from Institut National Belge de Radiodiffusion, Brussels, lists Leopoldville transmitters at OTC-1, 17.770; OTC-5, 9.745; and OTC-3, 9.380, being kept as a reserve; OTC series is 50 kws.; and OTM-3, 9.380, OTM-2, 11.720, with 7.5 kw., and OTM-5, 6.282, with 3 kw. (Ferguson)

BELGIUM—New Zealanders report picking up Brussels on 11.850 between 3:45-4 p.m.; poor signal. (Milne) Direct from Brussels, it is learned that Ruysselede, 17.845, is used for telecommunication between Brussels and Leopoldville, Belgian Congo, 12:45-1:15 a.m., 5-6:30 a.m., 10-11 a.m., and 1-3:30 p.m., irregularly. (Ferguson)

BRITISH BORNEO—According to John A. Hunt (G2FSR/VS4JH), now in London, "no station has yet operated on the s.w. bands from any part of British Borneo, only amateur stations VS4JH and VS4RM, operated by myself until recently."

BRITISH SOMALILAND—*Radio Somali,* 7.126, operates on Tuesdays and Thursdays between 9-10:30 a.m. (BSWL) Has fair signal on Thursdays at 9:30 a.m. when it has *English* program. (Dilg)

BULGARIA—*Radio Sofia,* 9.350 (varying), is heard in Massachusetts at 3:30 p.m. with *English* news, through heavy CWQRM; weak signal. (Sternfelt)

BURMA—*English* transmission from Rangoon, 8:45-10:15 a.m., previously on 11.845, is now radiated on 9.540; usually has news just prior to closing down. (BSWL) Appears to be on 9.543 rather than 9.540, is badly jammed by VE9AI, Edmonton, Alberta, and *Radio Australia,* on 9.540. (Dilg)

CANADA—CHOL, 11.72, and CKLO, 9.63, Montreal (transmitter at Sackville, New Brunswick), sign off the European beam at 6 p.m.; last *English* newscast is at 5:45 p.m. (Balbi) VE9AI, 9.54, Edmonton, Alberta, is reaching out these days, being heard in Sweden between 8-9 a.m. *(Night-Owl)* CBRX, 6.160, Vancouver, British Columbia, appears to sign on now at 10 a.m. (Dilg)

CEYLON—*Radio* SEAC on November 4 moved its 100 kw. transmitter from 15.120 to 11.770 mornings. (Balbi) Official schedules just in from Colombo, confirming change at 7:30 a.m. from 15.120 to 11.770, are as follows:

Main Programs—7:30-10:30 p.m., 15.12 and 6.075; 10:30-11:30 p.m., 15.12; 11:30 p.m.-3:30 a.m., 15.12 and 6.075; 4:30-7 a.m., 15.12 and 6.075; 7-7:30 a.m., 6.075; 7:30 a.m.-12 noon, 11.77 and 6.075.

Special Services (Educational transcriptions and Indian Forces' Program)—10:30-11:30 p.m., 11.77 and 6.075; and 3:30-4:30 a.m., 17.77, 6.075, and 11.77 (alternative). These schedules "are subject to change, of which

the only warning will be preliminary microphone announcements. The following additional frequencies are likely to be brought into use for the benefit of listeners in Malaya, Netherlands Indies, India, China, and Japan—17.77 and 9.520."

The 6.075 transmitter is heard in Sweden around 10:30 a.m.-12 noon sign-off. (Gilbert Andersson) Australians report the 6.075 frequency is paralleled by 6.180 (?) after 7:30 a.m.

CHINA—Australian sources say it has been almost conclusively proved that XGAP is the callsign of the Chinese station operating (probably from Kalgan) on 9.625; these letters are spelled out on opening at 5:45 a.m. and on closing at 9:30 a.m.; other callsigns are given during the broadcast period, apparently from stations in relay.

In the United States, reception from the various Chinese transmitters appears to continue poor. XGOY, Chungking, on 11.920 (varying), is heard from around 10.45 to 11:45 p.m. signoff; *English* news is scheduled for 11 a.m. On 9.640, XGOY is heard earlier in the morning to around 10:30 a.m. signoff, *English* news is scheduled for 9 and 10 a.m.; is usually inaudible now

(*Continued on page* 140)

Quality Before You Sell

(*Continued from page* 51)

for his family—not one too small that will give inadequate hot water nor one too large that will cost too much to operate. Thus your "Good Service" continues. During the sale you arrange satisfactory credit or terms; after the sale you take care of good

EASILY CONSTRUCTED DUMMY ANTENNA FOR RECEIVER MEASUREMENTS

By GUY DEXTER

RADIO servicemen and experimenters who desire to make receiver tests and measurements in the approved manner often deplore their lack of a regulation dummy antenna for connection between signal generator and receiver. Such dummy antennas are sold by precision instrument manufacturers, but usually are designed mechanically to fit the attachments of a specific signal generator (usually costly) or are priced out of the reach of most non-scientific users.

Fig. 1 shows the arrangement of a dummy antenna that can be built easily by any radio man. The electrical circuit employed is the one specified in I.R.E. Standards.

The entire unit should be built into a small metal can. One of the popular 4" x 4" x 2" steel shield boxes used for ham instruments will make an ideal housing. Coaxial jacks are mounted directly on the box for efficient connection of the two shielded lines.

C_1 and C_2 should be the smallest-sized mica capacitors (such as Aerovox type 1469 or Cornell-Dubilier type 5W), in order to minimize capacitor inductive effects. Each capacitor must be selected carefully for exact capacitance. R is a 400-ohm, 1-watt carbon resistor (or precision non-inductive wire wound resistor) likewise selected carefully for exact value.

The 20-microhenry coil, L, is made by winding 34 turns of No. 24 enamelled wire on a 1-inch-diameter form. The turns are spaced to occupy a winding length of 1 inch. The coil form should be polystyrene, ceramic, or low-loss (mica-filled) bakelite. The dimensions of the coil give it a good form factor. If a Q-meter or inductance bridge is available, the coil should be adjusted carefully for the exact 20 microhenry value. But if such a checker is not handy, the builder may strike the inductance value quite closely by adhering strictly to the winding directions.

All leads inside the dummy antenna case must be short. But the components must not be placed so close together that the capacitors and resistor come nearer to the coil than three-quarters of an inch. The capacitors must be mounted "on edge" so that their flat faces do not rest on the side of the metal box. This will reduce stray capacitance to ground. The coil must be mounted well away from the sides of the box, preferably in the center of the enclosure.

The coaxial line from the signal generator must be kept as short as possible. In fact, whenever possible, the dummy antenna case should be mounted on the front or side of the signal generator right at the latter's output terminals, in order to keep this connection short. The coaxial line to the receiver should not be any longer than absolutely necessary. A 2-foot length usually will be more than adequate to allow for moving the receiver about, tipping up on edge, etc.

A dummy antenna requires no adjustment nor manipulation. It merely is inserted between the signal generator and the receiver under test. It should be used when making all standard receiver measurements, such as sensitivity, image ratio, selectivity, etc.

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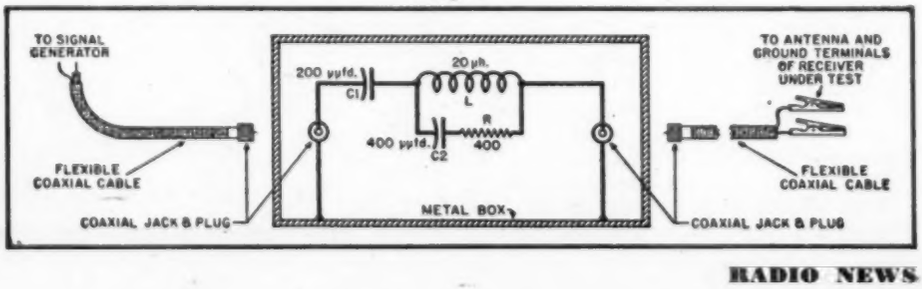
Fig. 1



installation; then you maintain the product. All are "Good Services."

Your first duty therefore is to supply your customer with a good product. You, in the selection of your lines, must make sure that the radios and appliances you offer to your customers are well built, well designed, reasonable in price and will do well, the job for which they are intended.

There will be quite a few new manufacturers looking for outlets for their goods. Don't make the mistake of letting an extra five or ten per-cent discount be the deciding factor. The best ad for any radio or appliance dealer is a satisfied customer. You can't have satisfied customers with inferior products.

In my opinion, which was formulated primarily by testing all sorts of radios and household appliances, most nationally advertised appliances are good appliances. This does not mean that appliances made by smaller companies are no good nor does it mean that all products made by the larger companies are super products. It does mean, however, that the larger companies, as a general run, make good, easy-to-sell products and for the following reason.

1. Practically all, in fact all that I know, of the larger companies have extensive engineering departments and research laboratories for product development, refinement and improvement. These companies are continually working on their products to make them better.

2. The larger companies have excellent manufacturing facilities. For example, in refrigerator and range manufacturing such things as roll-welded frames and bodies make for far more sturdy construction than nut and bolt assemblies. Then, too, the bigger companies make larger quantities of any particular product and these production quantities tend toward economy of manufacture. This usually means a better product at the same price.

3. All of the large manufacturing companies have excellent testing, inspection, and quality control set ups. The quality of production in many cases is superior to engineering standards. Component parts are tested and inspected, sub-assemblies are tested and inspected, and finally the finished product is rigidly tested and inspected. I know of several companies that have a system of engineering check that is designed to insure uniform quality production. In the case of a refrigerator manufacturer, a certain percentage of the finished refrigerators are uncrated after production and completely checked by engineering. These boys know that they have a good refrigerator. They keep it that way by spending a lot of money on quality.

4. All of the larger companies have a very close coordination between service department, engineering department and production department. If at any time a number of field failures on a particular point are noted,

the engineering department corrects the situation, and changes in the product are made to alleviate the condition. This too, makes for a better product.

5. All of the larger companies advertise their products. This makes it much easier for you to sell them. This advertising, in many cases, sells your customer before he comes into the store. Most of you know that the blame falls on you if the customer is dissatisfied with an unknown brand. If a nationally advertised product, in isolated cases, turns out to be a lemon, the purchaser is much more likely to forgive you and blame the right person—the person who made it.

The large manufacturer also offers advantages when it comes to service on appliances. Some of the reasons why this is so follow:

1. Most large manufacturers have many, centrally located service and parts depots. This enables you to obtain quickly needed parts, and in many cases the company service center will repair the defective appliance for you.

2. Practically all of the larger companies have complete service manuals and parts lists so that service on their products is greatly simplified.

3. Training classes for servicemen are held with the advent of new products. Color films and factory experts get the story across to your servicemen and make the job easier for you.

4. The service problem is continually being worked on by all of the larger manufacturers. They keep rigid records of all service calls and then design the products to simplify servicing. Remember the first automatic washers—it took several hours to replace a mechanism. Today, the same mechanism can be changed in about half an hour. These advances in design—pointed towards ease of service—save you much time and money in the long run.

The above seems to point out that the only safe course for a dealer to follow is to handle the products of a large, national advertiser. Strictly speaking, I do not mean that. The only way for a small manufacturer to get to be a large manufacturer is for him to get more dealers and sell more of his products. I repeat, *"Many small manufacturers make excellent products."* For the sake of your reputation, however, you should use care in picking the ones whose products you are going to handle. Get the answer to some or all of the following questions. If the answer is favorable there is no reason why you cannot promote these products and at the same time do a service to your customer and the manufacturer.

1. Will the product fulfill the manufacturer's or distributor's claims? This should be determined by test or through reliable sources.

2. Is the product well designed and constructed? This can be determined by comparison with proven products. Examine the construction, look for flaws or weak points.

3. Can it be easily serviced? Try

removing and replacing some parts. You'll soon know if servicing is difficult.

4. Are parts readily available? Find out the location of the nearest source of parts. See if the stock is complete.

5. What selling aids does the manufacturer offer? Check the ease of selling against other products. Folders, leaflets, window displays, cut away models and many other sales promotion features help you to sell.

6. Is the company reliable? Find out if they can back up their guarantees. Make sure you don't put a lot of effort behind something that will be out of the picture in a short time.

If you are sure that the contemplated line will give you good answers to these questions, then go ahead. You can then, with confidence, tell your customer that he is buying a good product; you can tell him that you have checked and you know. Remember again, the easiest sale you can make is by having Mrs. Jones tell Mrs. Smith that she bought a good piece of merchandise at *your* store.

After you are sure that you have "Good Products" and "Good Service" most of your "danger signals" have been taken care of. There is, however, one more important one that you must watch with care. It is really possible to sell a person a good product, that can be easily serviced, and still wind up with a very dissatisfied customer. Always make sure that you check the mechanical and electrical requirements of the appliance you sell against conditions in the customer's home. For example, when you sell a refrigerator, make sure that the size is adequate for his needs and make sure the door swings in the right direction. When you sell an automatic washing machine, make sure that there is an adequate supply of hot water so the machine will operate efficiently. When you sell a water heater, make sure it is properly sized. When you sell an electric range, make sure that the range can be installed with correct wiring for proper operation. When you sell a radio, make sure you don't oversell. I have seen many oversized console radio sets in small living rooms. When you sell a man in a small house a radio with twenty or thirty watts of audio output, you are overselling him. Thirty watts of audio output will knock the plaster off the walls in most small houses. Normal reception, in most homes, requires just normal audio output. When you sell small appliances, such as toasters, irons, room heaters, waffle irons, sandwich toasters, etc., make sure that the purchaser's home is adequately wired for the use of these appliances. The main thing to remember is, you cannot have a satisfied customer if he does not get full use of the product he buys.

Make a list of questions on each product you sell. Phrase these questions so that when you get the answers you know that the customer can make full use of that which you sell to him. This, in the long run, leads to more business. If you refuse to sell a man

an automatic washing machine because he does not have an adequate supply of hot water, you are doing him a service. Sell him a good, adequate hot water heater first, then the automatic washer. Perhaps in these cases your competitor will sell the product to the same customer. I say—let him do it. In the long run you will be better off. Most people will listen to reason—just give your customer good reasons.

All dealers are in an excellent position to improve the standard of living of all America. Do the job well—it's not easy—it's hard work—but the rewards are many. Just remember—*"Be sure of quality before you sell."*

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Your Shop Location

(*Continued from page* 31)

you are specializing in ship radio repair, you must have your shop near where the ships are. If you specialize in auto radio repair, there is no better place to have your shop than in or near the biggest garage in town, for here will come the largest number of automobiles needing repairs of one type or another. Always remember that the servicing of auto radios requires sufficient parking space for the cars themselves. Try to locate a shop with a yard or courtyard in the back, and with an entrance for autos from the street.

There are two other thoughts which should be considered in determining the proper shop location. The first is to try to anticipate either a "business trend" or a "population trend" in the vicinity of the proposed location. Remember that the business you establish will have a certain amount of "good will." This "good will" is built up slowly, yet it may become your biggest asset. "Location" is usually an integral part of "good will." If you must move because of the location becoming unsuitable, some of the value of your "good will" may have to be sacrificed.

The other thought is that many shops have been built up on AM receiver servicing. However, the times change, and when you pick your new location, study the potential need for radio service on FM, television, home and industrial electronic devices, inter-com units, home recorders, etc. Study these needs in the light of the shop space and location best suited to their requirements.

To sum up, the location of a proper shop site for your radio service business should be picked with the following thoughts in mind:

1. You must know your particular need and pick your site accordingly.

2. Work up a clientele at home before you risk too much money in the rental of a store.

3. Be sure that you are ready to take on the responsibility of a store.

4. Know the territory you intend to serve. Learn its real estate values,

its available stores, their relative advantages and their relative rentals.

5. If you intend to service only a portion of the town or city in which you have your business—locate your shop near the center of this area.

6. Check the type of businesses surrounding the shop site. Pick a store as near as possible to the heaviest flow of street traffic.

7. If you are interested in specialty repair service, pick your site near other firms who cater to the same type of trade.

8. Check the flow of traffic during different hours of the day.

9. Look for other advantages including proximity to transportation stops.

10. Avoid entrances that have "sales-killing" steps.

11. Watch to see that the place you pick will "wear well." That is, see that the neighborhood will not change over the period of several years and in such a manner as to make your location unsuitable.

12. If you want to get into one or more of the newer electronic servicing fields, study your location to see that there is a need for these services in that spot.

If you take your time, watch your step and learn about store values, you should be amply repaid. Above all, don't think that the time spent on the solution to this problem is wasted. You will have few more important decisions in your whole business life which can be of greater help to your success—if answered correctly.

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TUBE REMOVAL

MOST every radioman has available or can make a wire "skinning" tool of the type illustrated, or of spring steel with "V" shaped notches in the bent over ends.

This tool is also useful in removing radio tubes as may be noted in the photo.

Metal tubes may be removed while warm with a tool of this kind without danger of burning fingers. . . . H.L.

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

AMATEUR RECEIVER

The new *Collins* 75A receiver, which has been specifically designed for operation on the amateur bands, is described in a new 4-page bulletin just released by the company.

The bulletin lists several features of this receiver and includes circuit data, control information, frequency coverage, bandspread, image and i.f. rejection data, selectivity, etc. in addition to a block diagram of the receiver.

A copy of the booklet which covers the 75A amateur receiver will be forwarded upon request to *Collins Radio Company*, Cedar Rapids, Iowa.

ELECTRIC CONTROL DEVICES

In a compact, 8-page bulletin just released by *Ward Leonard Electric Co.* of Mount Vernon, New York, carries listings of a.c. and d.c. motor starters, speed and voltage regulators, resistors, ring and plate rheostats, switches, magnetic contactors, relays and dimmers.

Bulletin No. 100,000 is available for distribution to the readers of RADIO NEWS. Make your request direct to the company, *Ward Leonard Electric Co.*, Mount Vernon, New York.

SOUND SYSTEMS CHART

Of particular interest to the serviceman who installs and services sound systems is the new chart issued by *Mark Simpson Manufacturing Company, Inc.*

The chart offers general suggestions for handling different types of installations, and makes recommendations regarding the size of amplifiers that should be used to service particular applications.

A copy of this chart is available from *Mark Simpson Manufacturing Company, Inc.*, Long Island City, New York.

C-R OSCILLOGRAPH MANUAL

Although pertaining specifically to the *DuMont* Type 274 Oscillograph and designed to be used as an instruction manual, the new book "Operating and Maintenance Manual" issued by *Allen B. DuMont Laboratories, Inc.* contains much general information of interest to users of cathode-ray oscillographs.

The manual contains 39 pages of information plus a folded chart of the circuit schematic and constants of the Type 274. Several pages are devoted to the theory of operation of the cathode-ray tube and oscillograph circuits, complete with illustrations and diagrams.

Operating instructions deal with the alignment of AM and FM receivers and the use of the oscillograph in conjunction with radio transmitters.

These manuals are available at a charge of $.50 each from the *Allen B. DuMont Laboratories, Inc.*, 2 Main Avenue, Passaic, New Jersey. Payment must accompany your order.

ANTENNA EQUIPMENT

The Workshop Associates, Inc. have just issued a series of data sheets covering their line of antennas and antenna masts.

Included on the data sheets is information regarding the electrical and mechanical design of beam antennas, and dipole antennas for amateur applications. Antenna mast and mount, accessories for rotating masts and stand-off insulators are also listed.

Copies of these data sheets will be forwarded to interested persons upon request to *The Workshop Associates, Inc.*, 66 Needham Street, Newton Highlands 61, Massachusetts.

REGULATED POWER SUPPLY

Pan American Electric Company of New York has announced the availability of a data sheet covering their regulated power supply, Model PAS-2000.

Included is application data, circuit design information, electrical characteristics, mechanical characteristics and a summary of specifications.

The reguated power supply described is suitable for use as a component for production testing equipment requiring stability of performance.

A copy of this data sheet will be sent upon request to *Pan American Electric Company*, 132 Front Street, New York 5, New York.

SHURE CATALOGUES

The recently issued 1946-47 *Shure* catalogues, covering the company's microphone and pickup lines, feature several innovations in catalogue design which, according to the company, will facilitate the proper selection of equipment with a minimum of trouble.

Catalogue 155 illustrates the *Shure* line of microphones and features an article "How to Select the Proper Microphone" covering requirements, types, polar response, characteristics, and frequency response.

Catalogue 156 shows the line of "Glider" crystal phonograph pickups and lever-type cartridges. It also features an article entitled "Facts You Should Know About Pickups" which includes a discussion of needle-point compliance, tracking angle, tone arm mass, voltage sensitivity, type of

needle, amplifier input circuits, and surface noise.

In both of these catalogues emphasis has been placed on readability and imparting detailed information on applications, technical data, construction, design, etc.

Copies of these catalogues may be secured from *Shure Brothers, Inc.*, 225 West Huron Street, Chicago 10, Illinois.

PARTS CATALOGUE

Scenic Radio & Electronics Co., has just issued a new 16-page catalogue covering test equipment, sound apparatus, phonograph players, automatic record changers, speakers, tubes, microphones, antenna kits, radio text books, etc.

Listed in the test equipment section are volt-ohm-milliammeters, signal generators, tube testers, oscilloscopes, v.t.v.m.s., and signal tracers.

The company will forward copies of this catalogue free of charge to those requesting them from *Scenic Radio & Electronics Co.*, 53 Park Place, New York 7, New York.

BALLAST BULLETIN

The *JFD Manufacturing Company* of Brooklyn has recently announced the publication of a new a.c.-d.c. ballast bulletin.

This new 4-page booklet contains complete listings of a.c.-d.c. ballasts for individual sets and a complete listing of the new, improved *JFD* aircooled adjustable ballasts.

This booklet will be sent free of charge to those who request a copy from *JFD Manufacturing Company*, 4117 Fort Hamilton Parkway, Brooklyn 19, New York.

OLSON CATALOGUE

Olson Radio Warehouse has recently issued a new catalogue which should be of interest to radio servicemen.

Thousands of items are listed in this 32-page booklet including, microphones, amplifiers, intercoms, headphones, sound systems, speakers, record changers, pickups, and all types of radio components.

Copies of this catalogue are free for the asking. Address your requests to *Olson Radio Warehouse*, 73 East Mill Street, Akron 8, Ohio.

PRICE AND DATA SHEET

Electronic tubes for amateur radio applications have been listed in a new price and data sheet currently being distributed by the *Tube Division* of *General Electric's Electronics Department.*

The new sheet, ETX-19, has been introduced to facilitate the selection of tubes and provide a handy reference chart for all amateur applications.

Technical information and operating conditions data on over thirty tube types are contained in the new sheet. The information is presented in precise form and describes each tube available to amateurs from price to plate dissipation and power output ratings.

Distribution of the sheet will be handled by *G.E.* distributors or a copy may be secured from the *G.E. Tube Division*, Schenectady, New York.

ANTENNA SUPPORTS

Wind Turbine Company is distributing two data sheets which should be of interest to amateurs and serviceman readers of this magazine.

Information is furnished on several types of FM and television antenna supports as well as specification on a rotary beam antenna support for a four element 20-meter array.

Copies of these data sheets will be supplied upon request to the *Trylon Tower and Antenna Division, Wind Turbine Company*, West Chester, Pennsylvania.

ELECTRO-VOICE BOOKLET

One of the most valuable features of the new *Electro-Voice* catalogue, which has recently been released, is a page devoted to an easy-to-read guide to the selection of the proper microphone for specific applications. Listed

in chart form, this guide specifies 26 different applications for which microphones are needed and then indicates which type of microphone would most likely be best suited for that particular use.

In addition to listing data about 22 types of microphones, this 19-page booklet also carries a section devoted to a brief summary of the technical information pertinent to the operation of the various types of microphones.

Copies of this catalogue, No. 101, are being distributed by *Electro-Voice, Inc.*, Carrol and Cecil Streets, Buchanan, Michigan.

HEXACON FLYER

Details on the new *Hexacon* "hatchet type" soldering iron and information on various applications of this tool are included in the single page flyer just released by *Hexacon Electric Company* of New Jersey, for servicemen and manufacturers.

A copy of Form 140 covering this equipment will be sent to those requesting it. Direct your reply to the *Hexacon Electric Company* of Roselle Park, New Jersey.

MILLEN CATALOGUE

A new component parts catalogue for 1946-47 is currently being distributed by *James Millen Manufacturing Company, Inc.* of Malden, Massachusetts.

Included in this 24-page listing is information on transmitting condensers, dials, drives, scales, knobs, receiving condensers, standoffs, bushings, sockets, r.f. chokes, delay lines, antenna devices, safety terminals, plate caps, binding posts, beads, couplings, coil forms, filters, i.f. transformers and various chassis and other components used by the radio industry.

Both servicemen and manufacturers will find this catalogue of considerable value when ordering component parts.

A copy of this catalogue will be sent to those requesting it from the company, *James Millen Manufacturing Company, Inc.*, 150 Exchange Street, Malden, Massachusetts.

SERVICING ITEMS

Of interest to radio servicemen, electronic and radio manufacturers and industrial maintenance men is the new catalogue just released by *General Cement Mfg. Co.*

In this 24-page Catalogue No. 147, are listed hundreds of popular servicing items such as radio cements, polishes, varnishes, cleaners, knobs and accessories, phono needles, dial belts, tools, testers, switches and radio hardware.

A copy of Catalogue No. 147 will be forwarded upon request to *General Cement Mfg. Co.*, Rockford, Illinois.

SPEECH EQUIPMENT

Collins Radio Company has just published a new and complete broadcast speech equipment and accessories

catalogue which should be of interest to the broadcasting industry.

The new catalogue is subdivided to cover speech equipment, remote amplifiers, speech input consoles, mixing panels, program equalizers, console desks, relay panels, turntables and accompanying reproducing group, and various types of monitoring and measuring equipment.

Designed to facilitate the easy selection of equipment, this catalogue includes 40 pages of valuable data. Copies of this catalogue are available from *Collins Radio Company,* Cedar Rapids, Iowa.

HEAVY DUTY RELAYS

Signal Engineering & Mfg. Co. of New York has just released a four-page data sheet covering their new line of heavy duty multiple arm relays.

Data has been presented covering basic design features, contact ratings, circuit arrangements and other pertinent information.

A copy of Bulletin 30 will be sent to those requesting it from *Signal Engineering & Mfg. Co.,* 150-4 W. 14th Street, New York 11, New York.

SUPERIOR BULLETIN

A new catalogue, which replaces all of the previous publications by the company, has just been issued by *The Superior Electric Company* of Bristol, Conn.

Bulletin 150, as the new catalogue is designated, includes charts, circuit diagrams, and other data pertaining to Powerstat variable transformers, SECO automatic voltage regulators and Voltbox a.c. power supplies.

The material is presented in easy-to-read form to facilitate ordering the proper equipment for the job.

In addition to listing the equipment the company has in production, the bulletin offers engineering service on specialized problems faced by the manufacturer.

A copy of Bulletin 150 will be forwarded promptly to those requesting it from *The Superior Electric Company,* 713 Laurel St., Bristol, Conn.

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Radio Controlled Flight

(*Continued from page 27*)

with a high-powered v.h.f. radio receiver which can filter out a single channel, or any of the ten audio-frequencies. The v.h.f. transmitter may be located either in a ground installation or a mother aircraft, or, in some installations, both.

Each of the ten audio-frequencies or tones, when filtered, actuates a relay which, in turn, accomplishes a distinct flight function. The drone's mission determines the variety and choice of functions which can be accomplished by radio in any particular set-up.

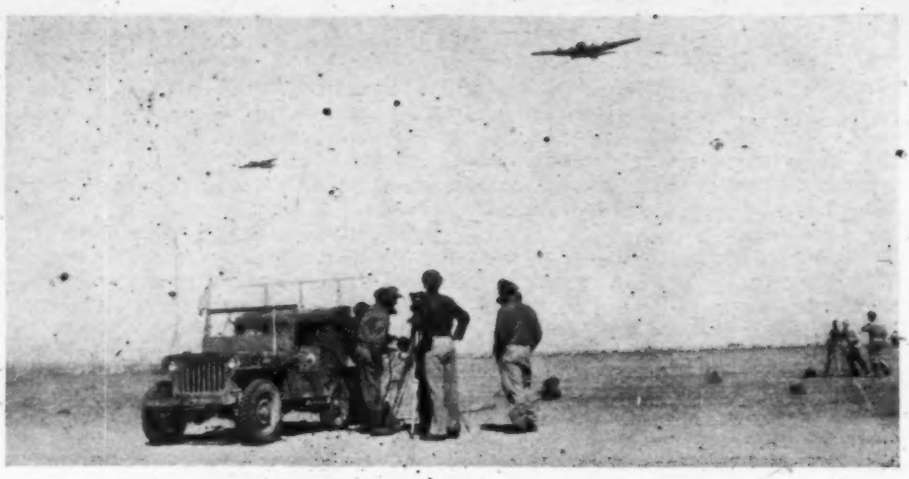
A control box installed in a jeep, or other ground station, supervises the takeoff of the drone until an airborne mother plane takes over. Either the ground station or the mother plane can control the drone up to a distance of 75 miles. However, effective control varies with the quality of radio reception.

In addition to its radio receiving set, the drone carries two television transmitters. One is trained on the instrument panel and the other on the outside atmosphere. The control pilot can, by flicking a switch, place himself in the position of a pilot in the drone. He can view the area in front of the drone from the "pilot's" seat, or examine the control panel when blind flying is necessary.

The television units in the drone contain an infinity-focus optical system and television camera pickup tube, plus the necessary sweep and electrical circuits for transforming the light waves from the viewed scene into equivalent video signals which modulate the transmitter. A conversion unit generates signals which synchronize the scanning of the mosaic screen with the sweeps of the reproducer tube at the receiver.

The drone's radio receiver actuates the relay mechanism which operates the camera lens stop and optical filter, to prevent "burning" the mosaic, and the optical heating system which prevents fogging.

The transmitter in the drone may



"Mother" plane hovers near her drone. In foreground a jeep control station is about to "take over" the operation of landing the drone.

be adjusted to operate on any one of the ten separate frequency channels between 264 and 372 mc. This permits the simultaneous operation of ten separate sets within the general area without interference. However, a different antenna unit is required for each of the ten operating frequencies.

The FM radio control receiving equipment on the drone permits ground-to-air or air-to-air control up to a normal range of 18 miles. However, by the use of an r.f. amplifier unit the effective range may be stepped up to 75 miles. The receiver-selector incorporates an eight channel audio filter selector circuit for discrimination between the various tones received. A relay unit passes control voltages to the automatic pilot from the receiver output.

Normally, the altitude of the drone is automatically controlled by altimeter equipment installed for that purpose. However, the altimeter setting may be overridden, when necessary, by a special relay box.

The television receiving and reproducing system employed in the mother aircraft is a superheterodyne type receiver which amplifies the received signal and removes the video component from the carrier. It impresses this video signal on the grid of the picture reproducing tube, which in turn reproduces the scene viewed by the drone camera equipment.

This unit also generates the necessary horizontal and vertical deflection voltages for the cathode-ray picture reproducer tube. The scanning of the picture pickup mosaic screen on the drone, and the generating of sweep circuits for the picture reproducer tube on the mother plane, are synchronized by special pulses generated by the drone transmitter.

Closeup of jeep control station showing the control box in the foreground.

Ten different antenna units are supplied with each receiving set. They operate at spot frequencies within the frequency bank of 264 to 372 mc., and are located approximately 12 mc. apart. The antenna is gyro stabilized within the aircraft.

Operational and tactical use of the drone and other guided missiles is being subjected to a thorough evaluation by a group of highly-qualified specialists under the direction of Colonel Harvey T. Alness, commanding officer of the Army Air Forces 1st Experimental Guided Missiles Group at Eglin Field, Florida. It is his duty to subject to punishing tests new projects in the remote control field development of AAF engineers.

The following radio control and television equipment was used in the flight from Hawaii to the United States in *Operation Remote:*

a. Installed in drone aircraft:
   (1). AN/ARW-1 Radio Control Receiver
   (2) AN/AXT-3 Television Transmitter
b. Installed in mother aircraft:
   (1) AN/ARW-18 Radio Control Transmitter
   (2) AN/AXR-1 Television Receiver

The AN/AXT-3 differs from AN/AXT-2 in that it contains an additional optical system and conversion unit for televising flight panel data. All AN/AXT-3 sets were created through modification of AN/AXT-2 sets.

-30-

The U.S. Army metascope, used to detect the presence of infrared light. Small enough to be held in one hand, this instrument was used by paratroopers to detect the infrared radiation which signaled landing spots. A small lead-sheathed compartment in the base of the metascope, containing radioactive material, furnishes the power source for the device. When a control switch on the outer hull of the unit is set on "charge," energy from the radioactive material is used to charge a viewing screen which is thus made sensitive to infrared radiation. A periscope-like mirror with an infrared filter, located in the cover of the unit, is raised to pick up the infrared light.

International Short-Wave

(*Continued from page* 128)

in Eastern U.S. A Chinese station heard mornings on the West Coast on approximately 6.050 *may* be one of the new Nanking transmitters. (Dilg)

XTPA, 11.650, Canton, is coming through again early mornings to the East; appears to use only Chinese in programs, but does announce call in *English* at times.

Since China has gone back to standard time, XNCR, 7.520, Yenan, is scheduled 7-8:30 a.m.

XORA, 11.695 (varying), Shanghai, has poor signal on West Coast this winter. (Dilg) Was fair to good early mornings here in West Virginia during later summer and early autumn, but has been inaudible lately.

CZECHOSLOVAKIA — Prague's OLR4A, 11.84, is being heard opening at 3 p.m. *daily;* starts *English* program at 3:30 p.m., with the news being read at 3:45 p.m.; appears to use French at 4 p.m., Spanish at 4:30 p.m.; uses Dutch later on and usually identifies in German around 5:30 p.m.; the National Anthem ("Kde Domov Muj") follows and the carrier leaves the air at approximately 5:35 p.m. (Havlena) Sends fair to good signal here in West Virginia.

In the nightly North American beam, 7-7:30 p.m., OLR5A, 15.230, has a fair to strong signal; *English* news is heard *most* evenings, around 7:07 p.m. (Casey) I note that more fluent *English* is being broadcast.

DENMARK—OZF, 9.520, Copenhagen, is scheduled 12:30-5:30 p.m.; OZH, 15.320, is heard on same schedule, but *Sundays only no English.* (Friis) The new 50-kw. short-wave station is to commence operations early in 1947. (Cushen)

DOMINICAN REPUBLIC—Glynn Moss, Ontario, sends along this information secured direct from a friend employed at HI9T. This station is located in Puerto Plata and is called *"Broadcasting Tropical";* operates *daily,* 10 a.m.-2 p.m. and 4-7 p.m., except on Thursdays when the evening transmission runs to 9 p.m. Frequency is 6.175.

ENGLAND—Latest official listings of the BBC's North American Service are: GWH, 11.80, 5-6 a.m.; GSP, 15.31, 6-8:15 a.m.; GRP, 18.13, 8-11:15: a.m.; GRP, 18.13, 11:30 a.m.-4:15 p.m.; GSP, 15.31, 4:15-7:45 p.m.; GWH, 11.80, 4:15-9:45 p.m.; GSC, 9.58, 4:15-11 p.m.; GRH, 9.825, 5-11 p.m.; and GSL, 6.11, 7-11 p.m.

GSK, 26.100, is reported to be carrying the African Service, afternoons.

European Service of the BBC is still being heard in the United States afternoons and after midnight on such frequencies as 7.120, 7.230, 7.260, 7.320.

FINLAND—From this country *English* news is being heard nightly at 7:25 p.m.; has Finnish between 7:35-7:45 p.m. sign-off; is heard in East on OIX4, 15.190, but woman announcer says OIX2, 9.505, is also being used at

the time of this beam to America.

FRANCE—Recently, *Radio Paris* was heard on 9.94 in the evening North American beam, beginning at 9 p.m. with *English* news, but at last report was back on 9.550; 11.845 is in parallel and is the better signal. (Balbi) Appears to have dropped the 10:30 p.m. *English* news repeat. (Cooper)

FRENCH INDO-CHINA—*Radio Saigon's* evening transmission on 11.778 is now heard 6-7:15 p.m. (Balbi) I believe this is entirely in French. A good signal is heard from this station at 5-5:30 a.m. when *English* news is given. According to Swedish observers, the 4.810 transmitter is heard there well at 5:30-6 a.m.

Rex Gillett, Australia, reports that after a short period on about 9.580, Hanoi is again being heard back on 9.600; at the conclusion of *English* news about 6:15 a.m., the station announces, "You have just been listening to the day's news broadcast from Hanoi, Indo-China." Later in the day, Hanoi is heard in Australia on 11.900; modulation of both outlets is always poor.

FRENCH WEST AFRICA—*Radio Dakar,* FHE3, heard signing on at 1:45 p.m., usually is blocked out by WLWS, 11.710, when latter takes to the air at 2:15 p.m. (Harris)

GERMANY—Leipzig, 9.680 (listed as 9.688), *"Mitteldeutscher Rundfunk,"* is heard in Denmark with a powerful signal, 8 a.m.-2 p.m. and between 4-6 p.m. (Friis) *"Berliner Rundfunk,"* 6.072, has *German* news between 11:45 p.m.-12:10 a.m.

DTCY, the 100-kw. American shortwave station in Munich, 5.3025, is still testing each Monday, Wednesday, Friday at 9-9:30 a.m.; address, The Military Government Station DTCY, A.P.O. No. 170. (Skoog)

BFN, 7.290, Hamburg, carries same program as AFN, 6.078, Saturdays, 6-7:20 p.m.; should not be confused; BFN often relays BBC's GFP. (Harrison) In British Columbia, is heard opening at 1 a.m., relays BBC's "7 o'clock news" at 2 a.m.; good signal. (Cooper)

GOLD COAST—ZOY, announcing as on 61.04 meters (probably is 4.915), Accra, is heard in South Africa daily from 12 noon to 1:30 p.m.; relays BBC news from London at 1 p.m., followed by local news and schedules. (BSWL)

GUADELOUPE—*"Radio Guadeloupe,"* 5.985 (varying), was recently picked up at 7:35 p.m., still going at 8:05 p.m. (Bromley)

GUAM—According to Australian and New Zealand sources, it is probable that WXLI, *"Radio Barrigada,"* 1380 kcs., using 325 watts at present, will add short-wave facilities, in addition to becoming the main U.S. outlet in the Western Pacific area.

GUATEMALA—TGWA, 15.170, has fine signal now, evenings. (Harris)

HOLLAND—PCJ, 15.220, Hilversum, appears to have daily morning broadcast beginning at 8 a.m. (Grivakis) This is probably beamed to Netherlands East Indies. *PCJ will celebrate its 20th anniversary this year.*

HONG KONG—According to a recent DX broadcast from *Radio Australia,* ZBW is now operating on 9.540; West Coast monitors report the frequency rather as about 9.538; poor signals are heard some mornings here in the East, around 6:30-6:45 a.m.

INDIA—VUD7, 6.19, Delhi, now signs on at 10 a.m., is audible on West Coast to around 11 a.m. (Balbi) The 15.16 frequency is heard well both East and West Coasts mornings; some days has surprisingly good signal here in West Virginia at late as the 9:30 a.m. *English* news period. The 8:30 a.m. *English* news is heard well some mornings on 11.850.

Calcutta's 7.21 is used in parallel with Delhi's 15.16, 11.87, and 9.59, mornings; *English* news is at 7:30 a.m. Madras, on 7.255 (listed), also carries this 7:30 a.m. news. (Balbi) Calcutta goes down to the 3-megacycle band at 8 a.m. (Dilg)

Bombay is using 7.24 mornings instead of 9.63; carries *English* news at 7:30 a.m.; moves to 4.880 at 9:15 a.m. (Dilg)

IRAN—*Radio Teheran,* EPB, 15.100, can be heard some mornings in the eastern U.S. around 6:15 a.m. when it has *English* news; identifies in French at 7 p.m. as "Ici Teheran," then continues with French news; I recently heard the station leave the air abruptly at 7:30 a.m.

Swedish observers report EPQ, 6.155

(varying), is heard there around 11 a.m.

IRELAND—Bertram Podall, Vermont, writes that in April of last year, following directions given on a broadcast of *Radio Eireann,* he wrote to the Consulate General of Ireland, Chrysler Building, New York City 17, and received a letter from that office stating that his report was being forwarded to Dublin and that he would hear from there. In two months he did receive a letter thanking him for his report "and to confirm your reception of the 4th of April." The verie came from Office of the Engineer-in-Chief, Department of Posts and Telegraphs, The Castle, Dublin.

ITALY—*Radio Italiana,* 9.630, Milan, is being heard in Denmark, 1-6 p.m. (Friis) Comes in to West Coast well by 5 p.m.; has bird identification; Italian news is at 6 p.m., just prior to closedown; has occasional identification in *English.* (Cooper) Is heard on 11.810 afternoons in East, has *English* period between 1:20-2:10 p.m.; announces 9.630 as in parallel. (Grivakis)

JAPAN—JLP, 9.605, Armed Forces Network, Tokyo, off since November 1. (Bilbi) I recently heard JVU2, 11.845, Tokyo, in contact with San Francisco between 7-8 a.m., excellent signal.

The Home Service from Tokyo is heard early mornings "back at the old stand" on 7.258, 7.285, 9.560, 9.505, 4.930, 4.910, and others. (Dilg)

JAVA—Rex Gillett, Australia, reports that a recent letter received from Lieut. W. Werner, formerly of *Radio Balikpapan,* Dutch Borneo, stated that a new 100-kw. transmitter has arrived in Java from the United States and that a suitable site in either Batavia or Bandoeng was being sought. Whether this is for shortwave or BCB use was not indicated.

The Indonesian operating on approximately 12.002 was heard by Australians to announce location as Djokjakarta; was heard at 5 a.m.; signals in Australia are only fair; is heard in certain parts of the U.S. also, particularly in the Deep South.

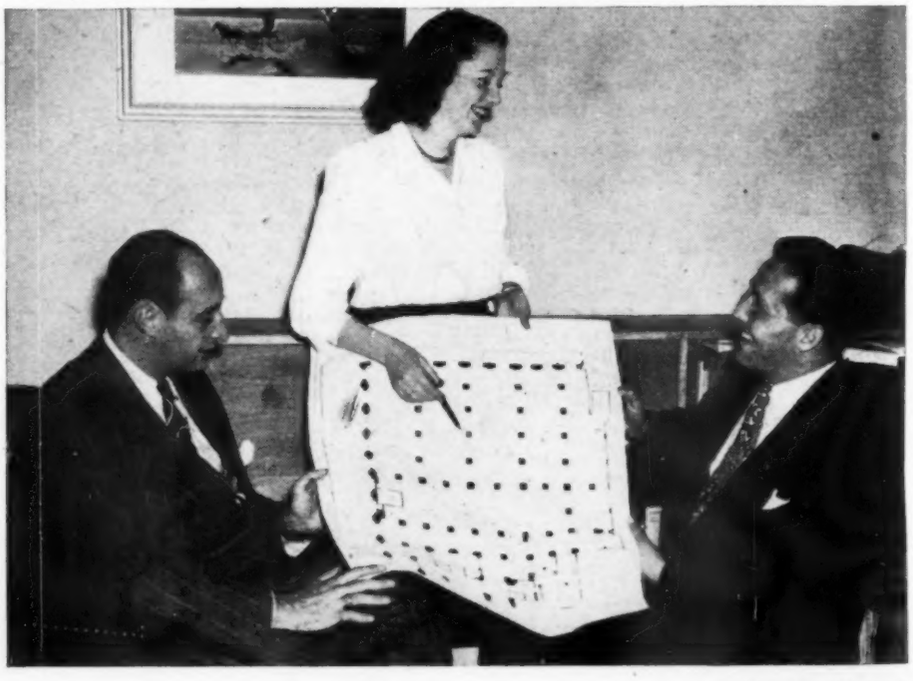
From South Africa, Mervyn Laubscher reports the Indonesian on 8.000 is heard as early as 8:30 a.m. with weak signal; at 9:30 a.m. announces program for Dutch Forces and has requests until 11:30 a.m.; announcements are mostly in Dutch, but at 11:30 a.m. sign-off a man announces in *English,* "This is the Official Dutch Station in Bandoeng"; further *English* announcements are quite irregular, sometimes they announce frequencies but usually just say that they're signing off and wish everybody "Goodnight." Time in Bandoeng at 11:30 a.m. EST is given as "midnight." Announced wavelengths of 99.5 and 37.5 meters (3.015 and 8.000, respectively).

LUXEMBOURG—*Radio Luxembourg,* 6.092, is heard with an *English* session between 3-3:30 p.m. (Milne)

MADAGASCAR—*Radio Tananarive,* 6.138 and 6.063, is heard on West Coast most mornings; at times, however, only the 6.063 transmitter is audible. (Dilg)

MALAYA—Singapore's 15.275 is heard well early mornings in Colorado. (Woolley) The 15.300, 15.275, 11.735, and 6.77 frequencies open now at 3:45 a.m.; *English* periods are at 3:45, 6:30, 7:30, and 9 a.m.; oriental type sessions are broadcast during the intervening times; the station closes down at 9:30 a.m. (Gillett, RADIO CALL) "The Voice of Britain" period

Kenneth C. Prince, manager of the 1947 Radio Parts & Electronic Equipment Show (left) and Jack Berman, of Shure Brothers, Show president, inspect a floor plan of the exhibit hall at the Stevens Hotel in Chicago where record crowds are expected to assemble to view new radio components. Peggy Skeffington of the Show staff explains display arrangements. Drawing for exhibition space took place in N. Y.



appears to be scheduled for 8:30 a.m.

MANCHURIA—August Balbi, California, reports a station on 11.77, heard from 5 a.m., that may be MTCY, Changchun (Hsinking), listed on 11.775 with 20,000 watts. Manchukuo has been heard mentioned many times.

Australians report a station tuned on 7.275 at 8:30 a.m. with a news service in a Chinese dialect may be located in this country; such cities as Harbin and Hsinking are mentioned frequently; music is broadcast prior to 8:30 a.m. (Gillett)

MAURITIUS—Reports from several quarters that a s.w. station is operating from this island on the 41-meter band have *not* been confirmed. A careful check by Mervyn Laubscher, Johannesburg, South Africa, at my request, did not reveal a station operating from Mauritius. Mr. Laubscher reports, however, that his failure to pick up the station may have been because of bad static interference on that band; he will check further. It is possible the station reported was an amateur.

MONACO—*Radio Monte-Carlo*, 6.130, heard signing on at 1:30 a.m. with musical selection; then woman announces, "Ici Radio Monte-Carlo"; musical program follows. (Sutton) Is heard in England at 3:30-4:30 p.m.; badly QRM'd; uses single gong; woman announcer; French only; frequency appears to be higher than listed, probably about 6.135/40. (Harrison)

In a verification letter to a Scandinavian correspondent, Karl-Ake Bergstrom, *Radio Monte-Carlo* officials wrote: "We do not own our complete equipment yet, but we hope that the final installation will take place in 1947. Our transmissions are probably not heard very well at present because we have only one long-wave transmitter of 10 kw. on 410 meters and one *experimental short-wave* station of 300 watts on 48.95 meters. Our transmissions take place each day at 1:30-3:30 a.m., 6-8 a.m., and 1-5:15 p.m. We hope to be in a position to give better service starting in 1947 when our complete installation will be finished. *We will have a short-wave outlet of 25 kw. at the beginning of 1947* and our long-wave station will run with 120 kw., probably around July, 1947." A descriptive booklet on the Principality of Monaco was enclosed. The address is Administration-Direction, 16, Bd. Princesse Charlotte, Monte Carlo, Monaco.

MOZAMBIQUE—A station heard Sundays opening at 10 a.m. on approximately 4.910 is believed to be Mozambique; weak signal, but should improve during winter months. (Dilg)

NEW CALEDONIA—*Radio Noumea*, 6.210 (listed as 6.208), now gives power as 500 watts. (Gray) Operates around 2-4 or 5 a.m.

NEWFOUNDLAND—VONH, 5.970, St. John's, is heard well at 8 p.m. in *English* newscast.

NEW ZEALAND—ZLT7, 6.715, Wellington, appears to have left the air, possibly in preparation for advent of the long-promised new s.w. transmit-

ters from this country. Watch for the new ones early this year; listed assignments include ZL1, 6.080; ZL2, 9.540; ZL3, 11.780; ZL4, 15.280; ZL5, 17.770; and ZL6, 25.800.

NICARAGUA—YNFT, 7.502, Granada, "La Voz de la Sultana," is heard signing off with march at 10:19 p.m. (Bromley)

NORTHERN RHODESIA—ZQP, Lusaka, broadcasts experimental transmissions daily from 10:30 a.m. to 12 noon on 80.5 meters; I believe the frequency is around 3.640 (listed, but may be as high as 3.690); on Sundays closes at 11:30 a.m. *English* and native programs are broadcast, and reports are invited. Address, Information Officer, P.O. Box 209, Lusaka, Northern Rhodesia. (BWSL) Bill Croston, Ohio, reports ZQP, 3.914, 10:30 a.m.-1 p.m., with weak signal and bad fade.

NORWAY—According to the BSWL, Oslo conducted tests for the British Isles in August, ending at 5 p.m., on frequencies announced as 6.130, 6.180, 9.540, and 11.735.

NOVA SCOTIA—CJCX, 6.010, Sydney, is being heard in Sweden at 6:30 p.m.; this is good reception inasmuch as CJCX is listed as using only 1000 watts.

PALESTINE—The *"Sharq-al-Adna"* station at Jaffa appears to have replaced its 6.710 frequency with 6.170; 6.135 and 6.790 are usually in parallel, heard opening at 11 p.m. in East (some Eastern DXers report sign-on as early as 10:30 p.m.) and around 9-10 a.m. in West.

PANAMA—HOX series, Panama City, is one of the most widely reported stations that took to the airwaves during 1946. It has been heard in such widely separated parts of the world as Northern Europe, Africa, and New Zealand.

Direct from W. T. Morrison, Chief Engineer, comes these schedules: HOXA, 15.100, 12 noon-9 p.m.; HOXB, 11.810, 9-11 p.m.; HOX, 940 kcs., transmits 12 noon-11 p.m. with 1,000 watts. The short-wave transmitter is a RCA Et-4750, 7500 watts. Spanish is the principal language used, but *English* news is scheduled for 6 p.m. and 10:55 p.m., news in Spanish is heard at 1 and 7 p.m.

Mr. Morrison is planning a special DX broadcast, dedicated to readers of RADIO NEWS, *for some time later in the winter.* Address of this station is Box 1335, Panama City, Republic of Panama.

HOLA, 9.505, Colon, *"Radio Atlantico,"* is heard around 8:45 p.m. with an *English* program.

PHILIPPINES—KZRH, 9.640, Manila, is heard in Denmark closing at 11 a.m. (Friis) Australians report this station is heard "Down Under" around 6 p.m. (Gillett) A verification letter received by Mervyn Laubscher, South Africa, indicates this short-wave transmitter is affiliated with NBC; has an 18-hour schedule *(daily to 11 a.m.)*, and uses a medium wavelength also. Address is Manila Broadcasting Company, Inc., 7th Floor, Insular Life

Building, Manila, Philippines. Mr. Laubscher says he finds this station audible only for few hours prior to the 11 a.m. sign-off, strength is weak to fair; reception in July, when he sent in his report, was much better than it has been this winter. In New Zealand, KZRH is a good signal from 4 a.m. (Milne)

KZRM, 9.590 (listed as 9.570), is being heard in Denmark starting at 10 p.m. (Friis)

POLAND—*Radio Polskie,* 6.100 (varying), has *English* news now at 3:15 p.m., according to British sources. Some reporters still list the time as 3 p.m., however.

PORTUGAL—CSX, 6.374, Lisbon, has a short session between 3:50-4:15 p.m. (Milne) Is good signal in New York between 5:30-7 p.m. sign-off. (Beck)

RUMANIA—According to the official house organ, *"Night-Owl,"* of the *Jonoping-Huskvarna DX Club,* Sweden, *Radio Romania Libera,* Bucharest, operates on a wavelength of 48.31 meters (assigned to a frequency of 6.189), 12:30-2 p.m.

The Bucharest transmitter on 9.252, *Radio Dacia Romania,* is heard in Sweden at 8:30 a.m. *(Night-Owl)* I believe *English* news is scheduled for that time.

SIAM—HSPP, 5.990, Bangkok, signs off at 9:45 a.m.; program is mostly in Asiatic languages. (Dilg) Reporters in Australasia say some *English* is heard.

SOUTH AFRICA—Johannesburg IV, 6.095, is heard in Sweden at 12 noon. *(Night-Owl)* Capetown, 5.877, heard 11:45 p.m.-12:30 a.m. now, with BBC news relay from London at 12 midnight. (Sutton)

FET15, 7.045, *Radio Cordoba,* is a good signal in New York at 6:55 p.m. sign-off. (Beck)

SWEDEN—Signals are improving greatly from SBT, 15.155, Stockholm, in the North American daily beam (*English* and Swedish), 10-10:55 a.m.; after usual chime interval signal, continues in Home Service, has *English* again around 12:35 p.m., leaves the air usually at 1:15 p.m.; the 10.780 frequency (SDB-2) is good in Home Service all afternoon to around 5:45 p.m. sign-off.

SWITZERLAND—HER3, 6.165 (listed as 6.166), Berne, is heard leaving the air at 5:32 p.m. (Bromley) HER4, 9.535, *not* HEI4, 9.539, is being used by Berne between 12:20-1:40 a.m., with HER3, 6.165, in parallel; opens with setting-up exercises; has German news at 12:45.

TAHITI—FO8AA, 6.980 (appears higher, about 6.99), Papeete, *Radio Club de Tahiti,* appears to be scheduled 10-11:45 p.m. or to 12 midnight, irregularly, Tuesdays and Fridays; uses French marching song (*not "La Marseillaise"*) prior to closedown which is usually without announcement. (Dilg) Heard 10 p.m.-12 midnight a recent Saturday. (Croston)

TANGIERS—The station on approximately 6.190, heard in England between 3-5 p.m. *(not complete schedule),* uses *English,* Spanish, French, and Arabian languages; identifies about every half hour in *English* as *"Radio International,* broadcasting from Tangiers." Usually has *English* at 4:45 p.m., but no news has been noted; poor signals. (Harrison)

TURKEY—TAP, 9.465, Ankara, is still reported on Sundays with the "Postbag" program, and to England, also in *English,* on Thursdays and Mondays, for fifteen minutes, all these periods beginning around 4:30 p.m. (Sternfelt) Has bad CWQRM here in West Virginia. On the same frequency is heard weakly some days at 12:45 p.m. in regularly-scheduled *English* news period; now coming through to West Coast again. (Cooper)

U.S.S.R.—Komsomolsk, 9.565, signs on at 9 p.m., off at 12:30 a.m., and back on at 3 a.m.; has *English* news now at 4 a.m. (Balbi) Some days Moscow can be heard in *English* beam to Britain at 12 noon on several frequencies in the 19-m. band (15.385, 15.412, 15.440). (Harris)

Although not announced, a Russian transmitter is being heard mornings on 11.720, from around 7 to 8:15 a.m., relaying Moscow's beam to North America; frequencies announced at 7:15 a.m. recently were 11.63, 15.18, 15.36, and 17.82. The 7 o'clock newscast is followed by Review of the Soviet Press and then a commentary; further news is heard at 8 a.m.; at 7:45 a.m. they announce addition of 9.565, 11.89, and 15.44.

New frequencies in Moscow's Home Service, heard after 10 p.m. on West coast, include 9.715, 15.23, 15.32, 11.745, and irregularly, 11.87. (Balbi)

Excellent signals are heard in England from Moscow on 6.160 at 5 p.m. when *English* news is presented. The transmitter on 6.020 (probably Kiev) is heard in European languages around 4-5 p.m.; Kremlin clock is heard striking at 5 p.m.; excellent signal. (Harrison)

Tiflis, 11.960, is heard 1-2 a.m. or later and also at 1:15 p.m., all Russian; Petropavlovsk (Kamchatka), 6.070, is heard on Sundays, 1-1:35 a.m., in British Columbia blots out Toronto; mostly music. (Cooper)

Kiev, 11.72, is being used yet in evening transmission to North America, 6:20-9 p.m., in spite of announcement of operating on 6.020; between 9-9:15 p.m. sign-off, uses Yiddish. Frequencies announced as used between 6:20-7:30 p.m. to North America include 7.36, 11.89, and 15.73; only the 7.36 one is audible in New York; transmitters announced for 6:20-9 p.m. are 7.24, 7.30, 9.48. (Beck) Some evenings they announce and are heard between 6:20-7:30 p.m. on 15.17.

U.S.A.—This interesting comment regarding reception of American shortwave broadcasters along the eastern coast of South America comes from Charles Mohr, written from Sao Salvador, Brazil: "I have been observing a phenomena the past few weeks

"No, you always interrupt me."

RADIO NEWS

which I have never heard about before. It may have been previously recorded, but if so, it has been unknown to me. From my observations, the beam of American short-wave stations is increasing in the number of degrees from 0 to 360. Stations on the East Coast of the United States (WRUA, WRUL, for example), beamed to Europe, have been heard fairly well near the end of October, whereas in September they were absolutely silent. Stations on the East Coast (such as WLWO, 11.790, for instance), beamed to Latin America, are heard with much poorer signals on the east coast of South America than they were during September. Stations on the West Coast of the United States (such as KNBX, 15.250, KWIX, 17.760), with main beams to China and Japan and with reciprocal (plus 180°) beams, which were heard with fair signals on the southern coast of Brazil, are now unheard. San Francisco stations beamed on Central and Southwest Pacific (KGEI, 15.130, and others), with reciprocal ordinarily over the eastern United States or the Caribbean, are being heard very well now." On the return trip to the United States, Mr. Mohr promises to let us know of any further developments in his observations regarding signals of U.S.

VATICAN—Listeners in England report HVJ, 15.100 (listed as 15.095) and 9.660, has *English* news at 9 a.m., and on 5.970 (listed as 5.971) at 1:15 p.m. BSWL) The 6.190 transmitter is heard in foreign languages during the afternoon to about 4 p.m.; some days the 9.571 transmitter has a talk in *English* at 2:30 p.m. (Harrison)

WESTERN SAMOA—ZMB6, 7.700, *Apia Radio,* which tested in early autumn around 12 midnight-1:05 a.m., has not been heard lately. (Balbi, Dilg)

YUGOSLAVIA—*Radio Belgrade,* 6.150, is heard 1-6 p.m.; the 9.420 (listed as 9:418) frequency is heard between 12 midnight-2 a.m.; both have fair to good signals. (Croston)

* * *

ACKNOWLEDGMENTS

ANGLO-EGYPTIAN SUDAN—Short. AUSTRALIA—Gillett; "Skyrider," ADXC; Wood, Radio Australia; Pye, Hallett. BRAZIL—Mohr. BRITISH COLUMBIA—Cooper, Virigin. BURMA—Burma Broadcasting Service. CALIFORNIA—Balbi, Crossley-Meates, Gould, Dilg, Curtiss. CEYLON—Radio SEAC, SEAC Forces' Radio Times. COLORADO—Woolley. CONNECTICUT—Beauregard. DENMARK—Friis; Johansen, Danish Short Wave Club. DISTRICT OF COLUMBIA—Howe, URDXC; Scully, Havlena, U.S.S.R. Embassy, Eaton. ENGLAND—Jones, Watkinson, Bowes-Taylor, Simpson, Short Wave News, Harrison, Hunt, ISWC, ISWL, Rowden, Short Wave Review, Friend, McGee, BSWL, Tonks, Norris, Daniels, Chang, Hall, Mitchell, White, Lloyd, FRENCH EQUATORIAL AFRICA—Jacques, Radio Brazzaville. HOLLAND—Koelmans; Startz, PCJ; de Groot. INDIA—Lalljee. INDIANA—Brimlow. KANSAS—Seckler. LOUISIANA—Smith, Crandall. MALAYA—Department of Broadcasting. MARYLAND—Grivakis, Weyrich. MASSACHUSETTS—Kernan, French, Florentine, Harris, Holzman, Sternfelt. MISSOURI—O'Connor. MONTANA—Steinmetz. NEW JERSEY—NNRC; Williams, American QLS Bureau; Wooley. NEW YORK—BBC, Casey, Legge, Australian News and Information Bureau, Ignoll, Beck, March, Sink, Dellins. NEW ZEALAND—Barr, NZDXC, Milne, Gray, Cushen. NORTH CAROLINA—Ferguson. NOVA SCOTIA—Brooman. OHIO—Berg, Sutton, Croston, Gates. ONTARIO—Bromley, Moss, Brook. OREGON—Hayre. PANAMA—Morrison, Radio Centro Americana. PENNSYLVANIA—Black, Callahan, Bachman, Cooley, Znaidukas. POLAND—Radio Polskie, Radio i Swiat. QUEBEC—Gauvreau. SCOTLAND—Wilson, Morris. SOUTH AFRICA—Laubscher. SWEDEN—Bergstrom, Skoog, Erik Petersson; Samsioe, Radiotjanst; Ekblom, Nils Johnsson; Sundback, "Night-Owl"; Carl-Eric Petersson, Lindhe, Gillbert Andersson; DX-News. TENNESSEE—Seaton. TEXAS—Thompson, Rice. VENEZUELA—Raper. VERMONT—Podall. VIRGINIA Norris. WEST VIRGINIA—Rupert, Reese, Gonder. WISCONSIN—Reed.

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The Electroplex

(*Continued from page* 39)

feedback between the plate and grid of V_{1B} through C_1 and R_1. The feedback is most effective for the higher frequency components of the transient negative voltage which is applied to the grid when the control switch is opened at a time when V_{1B} is conducting. The circuit is thus rendered relatively insensitive to the transient and tends to wait until V_{1A} begins conduction, then terminates the dash in the normal manner for correct timing.

Condenser C_6 connected between the fixed contacts of the control switch remedies a slight lag in response when the control switch is moved to the dot position.

A different type of relay may be used, provided that the series resistance of the relay coil and R_6 totals 7500 ohms. The plate current of V_{1B} is about 7 milliamperes but the relay should be able to close on 5 milliamperes.

The monitoring oscillator uses the amplifier section, V_{2A}, of a combination rectifier-amplifier tube. It is a blocking oscillator such as is used in sweep generators for radar and television equipment. It produces short pulses separated by time intervals much longer than the pulses. The output signal therefore has a very high harmonic content, resulting in a distinctively musical tone.

The fundamental frequency of the oscillator is dependent primarily on the discharge time of the grid condenser, C_8, and is practically independent of the resonant frequency of the tank circuit. A potentiometer, R_{15}, controls the positive bias to which the grid leak, R_{17}, is returned, thereby controlling the frequency of the audio tone. The fundamental frequency is variable from about 400 to 2000 cycles per second. The frequency control potentiometer, R_{15}, is mounted at the upper right-hand corner of the front panel.

Condenser C_9, not ordinarily found in blocking oscillator circuits, was found necessary in order to lengthen the pulses which otherwise were so short that their energy content was very low. The result was greater audio output power and a more pleasing tone quality.

The oscillator transformer, T_1, is a universal midget output type which has six taps on the secondary winding. It is connected to provide an impedance transformation from 8000 ohms plate-to-plate to voice coil. The oscillator tube, V_{2A} is rather lightly loaded and draws only about ten milliamperes plate current. The oscillator is a surprisingly efficient noise-maker, the volume control being normally set at about one-third of maximum. The volume control potentiometer, R_{19}, is mounted at the upper left of the front panel.

Since the frequencies of both the tim-

ing circuit and the oscillator are somewhat dependent on the plate voltage, it is desirable to maintain a constant load on the power supply. For this reason, the oscillator runs continuously with the output being keyed by short-circuiting the voice coil through the back contact of the keying relay, RL_1. This arrangement affects stable and clickless operation of both the oscillator and the timing circuit.

Power Supply

The power supply circuit is rather conventional and requires little comment except to point out the advantage of connecting the pilot light in series with the power line. It serves as a line fuse as well as an on-off indicator. Also, it indicates whether the audio oscillator is functioning properly. If the brilliance of the light changes when the oscillator is keyed, it is an indication that the oscillator is too heavily loaded and/or is not blocking. To reduce the loading, the output connection should be made to a lower impedance tap on the secondary winding of the oscillator transformer. The key has been found to operate satisfactorily from both a.c. and d.c. 115 volt power lines.

Construction

The arrangement of parts, as illustrated, is governed primarily by the desirability of minimizing waste space in order that the instrument may be as compact as possible. Fortunately, since the keying frequencies are less than 20 cycles, the layout problem is not complicated by consideration of stray capacitances and the leads may be as long as is expedient. However, leakage conductance through insulation or condensers must be minimized in order to prevent faulty operation. The condensers should be of the best quality and have a low leakage conductance.

The control switch was made from parts of an old "bug" and is mounted upside down on the bottom of the chassis. Both of the fixed contacts are mounted on a strip of lucite which is visible in the photograph. The lucite strip is secured in place of the arm which had previously supported the adjustable stop for the dot side of the old "bug."

The potentiometer R_3 and R_{12} are mounted on brackets secured to the chassis and their shafts are sawed off and slotted flush with the right-hand side of the cabinet where holes are provided for their adjustment. From the outside, these adjustments are inconspicuous, looking like ordinary screw heads.

The keying terminals are mounted on the back of the cabinet. The back and bottom of the cabinet are perforated with ¼ inch holes to provide ventilation. Ventilation holes are also drilled in the chassis wherever space can be found for them. The heat within the cabinet induces an adequate flow of air in through the bottom of the cabinet, which rests on rubber

bumper feet, and out through the holes in the back.

The smallest available parts were used throughout. As a result, the cabinet occupies about the same table space as the "bug" which it replaced. The dimensions of the cabinet are 6⅛ inches long by 3⅜ inches wide by 5¼ inches high.

The few adjustments of the control switch mechanism may be reached conveniently by unscrewing the four bumper feet which secure the bottom of the cabinet.

Adjustment

The adjustment of the key comprises setting potentiometers R_2 and R_{13} for the correct, or desired, dot and dash lengths. To insure the correct mark-to-space ratios of 1 for dots and 3 for dashes, the best method is to connect a volt-ohmmeter across the keying terminals. Switch the meter to the "ohms" scale. Set the speed control at about 25 words per minute. Then hold the control switch in the dot position and adjust R_3 until the meter reads exactly half-scale on any "volts" range. Now hold the control switch in the dash position and adjust R_{13} until a deflection of ¾ of full scale is obtained. No further adjustment of R_2 and R_{13} will be required as the mark-to-space ratios will remain substantially constant for all settings of the speed control. The relays should be set for a minimum space between contacts and for very light spring tension. Also, there should be at least 1/64 inch space between the relay pole piece and the armature when the relay coil is energized.

The nominal speed of transmission may be determined by counting the number of dots per second and multiplying by 2.5 or by multiplying the number of dashes per second by 5. The speed control may thus be calibrated directly in words per minute as is shown in the photograph. This nominal speed is attained when the operator properly executes the spaces between letters and between dots and dashes.

Modifications

It seems desirable to indicate a few modifications which appear feasible, though not confirmed experimentally. For example, the plate of V_{1A} might be coupled to the grid of a transmitter keyer tube which is normally biased beyond cut-off. The voltage at the plate of V_{1A} is of approximately rectangular waveform in accordance with the code signals being transmitted, with about 45 volts difference between maximum and minimum amplitude. The coupling circuit should include a blocking condenser of about 2 μfd. and the grid leak of the keyer tube should be at least one megohm. The 45 volt signal from V_{1A} must be sufficient to drive the grid of the keyer tube above cut-off voltage and thus turn the keyer tube on and off in response to the code signals.

Further reduction in size of the unit may be accomplished by the use of a

6J6 and a 6AL5 miniature tubes as V_1 and V_2, respectively. No important circuit changes would be necessary except provision for the correct heater voltage for these tubes.

Operation

The experienced operator will become proficient in the use of the *Electroplex* after one or two hours of casual practice. Numerals, such as 5 and 0 are easiest to send at the start and illustrate well the advantage of the key. A single test word should be selected and transmitted repeatedly at varying speeds until familiarity with the action of the key has been acquired. The basic rhythm established by the timing circuit is quickly picked up by the operator and he is soon transmitting almost perfectly timed code signals with maximum readability and minimum effort.

The beginner should set the speed control for at least ten words per minute even though he may leave much more than normal spacing between letters. As his skill improves, he will increase his speed by closing up the gaps between letters. Both he and his tutor will be pleasantly surprised at the accuracy of his sending and his rapid progress toward higher speeds.

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Practical Radio Course

(*Continued from page* 45)

non-linear element in single-electrode input type mixers in superheterodyne receivers designed to operate in the u.h.f. and s.h.f. ranges that are beyond the capabilities of even diode tube mixers. These miniature crystal rectifiers, which measure only ¼ inch in diameter by ⅜ in. length, are really wartime improvements over the Galena crystal detectors of the 1920 era, and are now made in compact, fixed form. Without them, present-day microwave and radar receivers would be impossible to construct.

Two types of these crystal rectifiers, both illustrated in Fig. 2, are in use. The germanium type constructed as shown at A contains a very small piece (⅛" square and about .025" thick) of crystal material consisting of a carefully controlled mixture of germanium and a small amount of tin. This is soldered to one lead wire. The exposed surface is highly polished so that the point of the springy tungsten wire catwhisker may be readily moved about until a sensitive spot is found, and then the unit is sealed. The theory which has been proposed to explain the operation of a crystal rectifier is too complicated to justify going into detail here. Briefly, the soldering of the crystal to the copper lead wire forms a large contact area, the tungsten contact point a small contact area and since, in certain crystals, electrons have been found to move more readily in one direction across such a junction than the other, rectification occurs. The outside case

is marked "plus" and "minus" to indicate that when the side marked "plus" is connected to the positive terminal maximum current will flow. The tungsten wire is at the end marked "plus."

The germanium crystal rectifier is rated for operation up to 100 mc. but it can be used on somewhat higher frequency. Its cathode-to-anode capacitance is only 3 $\mu\mu$fd., so it is suited for use in FM and television receivers which have high intermediate frequencies. For operation into low-resistance loads, this rectifier is said to be superior to vacuum tube diodes.

The silicon type, constructed as shown at B, employs a silicon crystal and a longer tungsten wire catwhisker. The silicon type crystal rectifier will operate satisfactorily at higher frequencies than will the germanium type, but it must be operated at lower current and voltage levels. One unit (*Sylvania* No. 1N21B) is recommended for 3000 mc. operation. Another (*Sylvania* No. 1N23B) is recommended for 10,000 mc. operation. Still another (*Sylvania* No. 1N26) is designed for 25,000 mc. operation.

Both the germanium and the silicon type crystal rectifiers shown in Fig. 2 are very rugged mechanically.

Operation of Crystal Rectifiers as Mixers

The treatment that has been presented here for the diode tube as a mixer applies in part to crystal mixers also. The circuit arrangement used for them, see Fig. 3, is also similar to that employed for the diode mixer, the crystal unit being substituted for the diode.

Like the diode mixer, the crystal mixer will convert in *both* directions, even though the ratio of forward current to back current may be as high as 1000 to 1 in some types. This action is minimized by suitably plating the crystal element before it is embedded in its fusible alloy mounting.

Because no frequency-conversion gain is obtained with them (actually a conversion *loss* of approximately 10 db. is sustained when they are employed), crystal mixers are widely used only in those receivers designed for operation on the u.h.f. and s.h.f. ranges where conventional forms of vacuum tube mixers and frequency converters would fail to operate satisfactorily. For this type of service they have no competition at the present time.

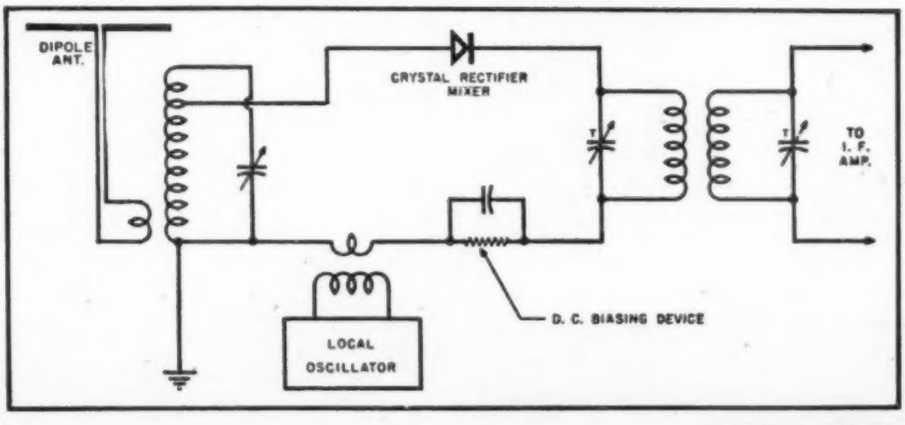
Due mainly to the fact that the capacitance existing across the actual crystal element acts as a bypass to the high-frequency voltage which would normally appear across the contact junction, the conversion efficiency decreases with increase in frequency. In the compact, well-designed, completely-enclosed cartridge type units now available (see Fig. 2), the internal structure has been designed to produce an exceedingly low amount of shunt capacitance. For example, the cathode-to-anode capacitance of the *Sylvania* 1N34 germanium crystal shown in Fig. 2A is only 3 $\mu\mu$fd. Because its capacitance is very low, the crystal rectifier's electrical time constant is very small.

Also, the resonance frequency of the crystal rectifier unit must be kept well above the highest operating frequency that will exist in the mixer circuit, for erratic operation results when the series resonance frequency of the crystal unit is approached. The series resonance frequency is made high by proper design that reduces the inductance of the contact lead and the capacitance across the crystal element.

Crystal rectifiers are not as uniform in operating characteristics as are diodes. Also, when used as mixers they must be protected from strong signals or r.f. fields that will set up sufficiently strong currents to damage the junction between the contact and the crystal. Consequently, they are unable to handle extremely high signal voltages and they must be protected from them, otherwise burning of the sharp catwhisker contact point will result.

An important advantage of well-designed crystal mixers besides their ability to operate at very high frequencies, is that they have a high signal-to-noise-ratio. Also, the fact that either or both sides may be operated above ground by any reasonable potential is a distinct advantage over the tube diode for many uses. Then

Fig. 3. Basic circuit for a frequency-converter stage in which a crystal rectifier is employed as the mixer. This arrangement is widely used in u.h.f. and s.h.f. receivers.



too, they require no heater or plate supply, so the possibility of hum is reduced.

The tabulation (Table 1) has been prepared to classify the various types of mixers and converters discussed in the last seven articles of this series, and to summarize pertinent information concerning the operation of each type. Also, the particular article of this series in which each type was discussed, and the illustrations in that article which refer particularly to it, are listed for convenient back-reference in the right-hand column.

This concludes our discussion of frequency conversion. The intermediate-frequency amplifier will be studied next.

(To be continued)

Crystal Diode Applications

(Continued from page 43)

screws to hold the disc in place. Drill a ⅜" hole in the other end of the tube shell and insert a grommet.

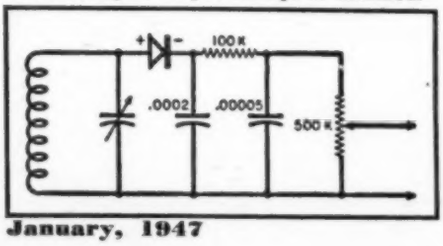
In the disc, which can be made of phenolic, polystyrene, or lucite, a banana plug is mounted for a probe. A 4-40 bolt is mounted off center on the disc to serve as a ground for the crystal diode, the condensers, and resistor. The probe in Fig. 1 was to be used at frequencies above 100 kc. so two 100 micromicrofarad Ceramicon condensers were used.

If audio frequencies are to be measured, a larger condenser would be necessary, as the effective impedance of the diode is lower than a tube diode. If this is kept in mind, the probe can prove quite useful. It can be plugged into the d.c. voltage jacks of your volt-ohm-milliammeter and will read peak a.c. volts. Provided it does not seriously load a circuit, it will measure a.c. voltages up to 100 megacycles.

With the 100 micromicrofarad condensers eliminated and a 1 microfarad condenser substituted, the meter will read audio frequencies accurately. The average volt-ohm-milliammeter uses a copper oxide rectifier for its a.c. ranges, which does not accurately indicate voltages above several thousand cycles. The crystal probe converts a volt-ohm-milliammeter into an audio output meter which is independent of frequencies. Remembering that the input impedance is in the order of several hundred thousand ohms, the readings would be reasonably accurate.

The crystal diode, plus a microam-

Fig. 4. Detector and a.v.c. circuit designed around the 1N34 crystal diode. This circuit differs from that of Fig. 2 in that higher output voltage is obtained.



meter and a dipole antenna, constitutes a simple field strength meter for measuring field strength and antenna patterns.

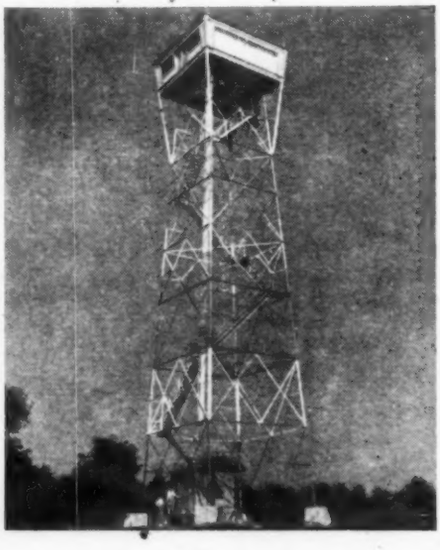
Substitute a pickup coil for the antenna and it becomes a handy resonance indicator for u.h.f. oscillators or transmitters. Being inexpensive and requiring no power, it would be very useful in portable or mobile equipment—for instance, in a portable transmitter-receiver, the diode could be used as follows: Mixer or first detector in the receiver; second detector in the receiver; a.v.c. rectifier in the receiver; rectifier on a.f. modulation meter in transmitter; rectifier in r.f. tuning meter on transmitter.

These five functions would normally have to be done with five diode tubes and, so, in the case where power is at a premium, the crystal would prove quite a battery saver.

In pulsed circuits, the crystal diode is also useful. It is here that we may make use of the fact that it provides a diode, together with its own load resistor. Useful, also, is its low forward resistance. For instance, if we have a piece of gear which is keyed off with a positive pulse but whose operation is erratic if the pulsing source contains some negative overshoots, then a crystal diode connected across this pulsed input will short out any negative going overshoots but will easily pass all positive pulses. Its back resistance, in the order of several hundred thousand ohms, constitutes the grid resistor of the input tube and, thereby, saves a part. It may, likewise, be used in d.c. restoration circuits whose resistance is not over several hundred thousand ohms.

A multivibrator may be improved by

General Electric's recently completed 130-foot steel tower located in the Helderberg mountains 12 miles from Schenectady. The structure at the top of the tower contains antennas, transmitting and receiving apparatus for the company's experimental microwave, two-way radio relay network to operate between New York City and Schenectady as a carrier for television and FM radio programs, facsimile and business machine circuits. Other such relay towers are now under construction.



connecting a diode from grid to ground on one or both of the multivibrator tubes. During the flip over period, one of the multivibrator tube's grids acts as a diode when it is driven positive. This grid, however, does not have a very low resistance in such a case, so it may be driven quite a bit positive, giving rise to an unwanted overshoot on the edge of the square-wave. Also, it takes an appreciable time for the coupling condenser to discharge, after this function has taken place. A diode connected from this grid to ground will keep the grid from being driven so far positive and will quickly discharge the coupling condenser which will steepen the square-wave output of the multivibrator and increase its frequency range.

There are a host of other uses for these crystal diodes, the low cost of which makes them practical where a tube and associated power requirements would be impractical. Its frequency response compares favorably with a miniature diode, which will make it as commonplace as the neon bulb in the ham shack. It has many ham applications, such as in noise silencer circuits, crystal detector in a monitor or frequency meter, tuning indicator and in antenna pruning. There will be other uses and it is hoped that this discussion will stimulate your thinking on the subject.

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For the Record

(*Continued from page* 8)

know what great brains are cooking up these new servicing plans, but we do know these facts: AM has created a force of nearly 60,000 dependable servicemen-dealers who have been reasonably gainfully employed in keeping the 60,000,000 AM receivers in working order. But servicing AM sets is supposed to be child's play compared to techniques that will be required to service FM and television. If any radio manufacturer or groups of manufacturers plans to develop a large organization to service FM and TV (and they confidently expect these media to be publicly accepted on a large scale) then they had better prepare to employ 100,000 to 150,000 technicians to handle the service which will be required in every city, town and hamlet.

Years ago, when the automobile industry faced a similar problem—they *did* something about it by supplying vital information to local blacksmiths and bicycle repairmen—the forerunners of our modern automotive mechanics.

Mr. and Mrs. Customer, especially farmers and others living in remote areas—many without telephones—are not going to sit around for a couple of weeks waiting for the serviceman to arrive. They would far rather rely on their local serviceman, just as they would their doctor, to be able to call on them promptly—when needed. O. R.

Within the INDUSTRY

LESLIE G. THOMAS has recently been elected vice-president in charge of manufacturing of *Solar Manufacturing Corporation,* of New York.

Mr. Thomas will have complete supervision of production at *Solar's* plants in Chicago, Bayonne and North Bergen, New Jersey. He has had extensive experience in the various manufacturing phases of the radio parts industry and until recently served as vice-president and works manager of *International Resistance Company* of Philadelphia.

* * *

NORMAN A. KOETKE has been added to the executive staff of the *National Electronic Distributors Association's* national office.

Mr. Koetke, who brings to the association a wide range of experience, will assist the executive secretary, Louis B. Calamaras.

The addition of the new staff member will permit an increase in the services rendered by the Association to its members. A monthly publication will be prepared for members to supplement the regular bulletin service now offered. Mr. Koetke's presence in the national office will release Mr. Calamaras and permit him to attend chapter meetings, visit manufacturers and appear before representative groups.

* * *

JOSEPH L. COLLINS has been appointed chief engineer of the *Aerovox Corporation* of New Bedford, Massachusetts.

Mr. Collins previously headed the Electrolytic Engineering Division and prior to that time was in charge of Electrolytic Engineering, *Sprague Electric Company.*

* * *

SAMUEL LUBIN, formerly a member of the new development section of the Technical Standards Division of REA, has recently joined the field engineering staff of *Sprague Electric Company* of North Adams, Massachusetts.

Mr. Lubin will be stationed in Washington, D. C. in charge of contacts with all government agencies and laboratories, including the Navy Department, Signal and Air Corps and the Departments of the Interior, Commerce and Agriculture.

During the war Mr. Lubin served as transition engineer of the Radio Research Laboratory at Harvard University. From 1932 to 1939 he was managing director of *International Radio Ltd.* of Tel Aviv, Palestine, representing American firms in North Africa and the Near East.

Mr. Lubin received his engineering training at Northwestern School of Engineering, George Washington University, Washington, D. C.

* * *

DON E. CORSON, well-known in the radio parts field, has recently been appointed to the post of manager of the Special Products Division of *Solar Manufacturing Corporation.*

Before joining *Solar,* Mr. Corson was associated with *Aerovox Corporation* in the capacity of sales manager of the Power Division and *Cornell-Dubilier Electric Corp.* where he served as sales manager of the Power Factor Division.

Mr. Corson is a graduate of M.I.T. and is a member of the American Institute of Electrical Engineers.

* * *

RALPH S. MERKLE is the new manager of parts sales for *Sylvania Electric Products Inc.* in which position he will direct the sales of small metal and mica parts, wire and welded wire products manufactured in the company's plants at Emporium and Warren, Pa. and Jamestown,, New York.

Mr. Merkle joined the staff of *Sylvania* in August of 1929 and has served as sales engineer, sales representative, commercial engineer and in the customer technical service department.

He was granted a leave of absence from June, 1942 until July 1, 1946 during which time he served in the Signal Corps and assisted in the development of the Joint Army-Navy electron tube program which resulted in the JAN specifications. He was discharged with the rank of major.

* * *

VICTOR E. OLSON has been appointed sales manager of the Receiver Sales Department of *Allen B. DuMont Laboratories, Inc.*

Before assuming his new post with *DuMont,* Mr. Olson was Eastern Sales Manager of the *Meissner Manufacturing Division* of *Maguire Industries,* in charge of dealer organization and sales promotion of their radio-phonograph combinations.

In his new position Mr. Olson will be

WILLIAM C. LEWIS, former chief of the *Stromberg-Carlson* government contract terminations department, has been promoted to the position of assistant sales manager.

A veteran of 17 years' service with the company, Mr. Lewis will assume many of the duties of the Rochester radio, telephone and sound equipment sales executives in order to free them for field activities.

* * *

MARVIN J. ALEF has been elected to the post of president and general manager of *Aviola Radio Corporation* of Phoenix, Arizona, according to a recent announcement made by the Board of Directors.

Mr. Alef is well known in radio, manufacturing, and merchandising circles having held executive positions with *Detrola Radio Corporation, Lee Anderson Advertising Company, Willys-Overland Company* and *Warren City Manufacturing Company* before joining *Aviola.*

Aviola manufactures a line of radios, record players and phono-combinations in addition to aluminum window frames and sashes.

* * *

GEORGE C. CONNOR has recently been named general sales manager of the *Electronics Division* of *Sylvania Electric Products Inc.*

Mr. Connor, who has been associated with the company since 1934, will be responsible for the merchandising and sale of electronic products, including special tubes, measurement controls, strobotrons, thyratrons, photo tubes and custom-built precision equipment.

responsible for the sales of *DuMont* television receivers.

* * *

MILTON E. LAUER has been named to the newly created post of Product Manager of the *Radio Tube Division, Sylvania Electric Products Inc.*

Mr. Lauer will be responsible for close coordination between manufacturing, engineering, sales and administrative departments with respect to all products of the Radio Tube Division.

He has been associated with *Sylvania* since 1933 and has served in various capacities in the production department of the company. From September, 1944 until June, 1945 he served as Chief, Production Scheduling and Distribution Unit, Electron Tube Section, Radio and Radar Branch of WPB.

* * *

During the early part of the war, Mr. Connor was liaison agent between *Sylvania Electric* and the government on the engineering development of radio and radar products, and in 1943 he established the company's West Coast sales office.

* * *

CARL W. MULLER has assumed his new duties as vice-president and general manager of *Sorensen & Co., Inc.* of Stamford, Conn., manufacturers of precision voltage regulator equipment and experimental and special electronic apparatus.

Mr. Muller received his degree in mechanical engineering at St. Mary's University. He served with the AAF from 1927 to 1939. During the war, Mr. Muller was stationed at Wright Field as project engineer on cold weather instruments for aircraft power plants. He was chiefly responsible for designing airplane instruments to withstand below zero temperatures.

He holds various patents on navigation instruments developed and used during the war in connection with Link trainers. He received the Civilian Meritorious Award for his development work.

* * *

ERNEST L. WARD has been named vice-president of *Sprague Electric Company* of North Adams, Massachusetts.

Mr. Ward, who joined the executive staff of *Sprague* in 1946, will include among his new duties the coordination of the manufacturing and service activities of the company.

Prior to joining *Sprague* Mr. Ward had extensive experience in the investment banking field where he specialized in industrial operations and organization.

* * *

LEE BUNTING has been named sales manager of *Garrard Sales Corporation* of New York, American agents for the *Garrard* Automatic Record Changer.

Before entering the selling field, Mr. Bunting was a radio engineer. His previous affiliations include, serving as project and commercial engineer of *Meissner Manufacturing Company,* Mt. Carmel, Illinois and sales manager of the Record Changer Division of *Maguire Industries, Inc.* of Bridgeport, Connecticut.

* * *

DON A. DAVIS, for several years chief engineering representative for the *Cannon Electric Development Company* of Los Angeles, has been appointed sales manager of the company.

Mr. Davis replaces William V. Brainard who resigned to form his own

sales promotion service. Mr. Davis joined *Cannon Electric* in 1941 as a member of the sales-engineering staff. He holds both an electrical and civil engineering degree from the University of California.

* * *

GEORGE O. CROSSLAND has taken over the post as district manager of the *Capehart Division, Farnsworth Television & Radio Corporation*, in the Philadelphia area.

Mr. Crossland's new territory will include Virginia, Maryland, Delaware, District of Columbia, the eastern section of Pennsylvania and the southern half of New Jersey. He will have charge of the distribution in this area of the new *Capehart* and *Panamuse* phonograph-radio instruments.

He is a graduate of Indiana University and has been serving as assistant manager of the sales division with headquarters in Fort Wayne.

* * *

L. W. HOWARD, formerly vice-president in charge of engineering for a West Coast transformer manufacturing company, has purchased the inventory and equipment of the *Electronic Components Company* and with O. D. Perry has formed the *Triad Transformer Mfg. Co.*, with offices and plant at 423 N. Western Avenue, Los Angeles 4, California.

Mr. Howard, who has had 16 years' experience in the transformer business, will have charge of engineering and sales and Mr. Perry, one of the founders of *Electronic Components Co.*, will be in charge of production.

The new company will manufacture specialized transformers for the radio, aviation, geophysical and other electronic fields.

* * *

SHERMAN K. HUGHES has been named general manager of the *Mark Simpson Manufacturing Company* of Long Island City, New York, manufacturers of sound systems.

Prior to joining the *Simpson* organization, Mr. Hughes was, for many years, associated with the *Jensen Manufacturing Company* of Chicago.

His appointment is in line with the new expansion program at *MASCO* which among other things includes the expansion of manufacturing facilities of the company. A recently erected 30,000 square foot factory in Long Island City will increase the production space of the company.

—30—

RADIO NEWS • 1946

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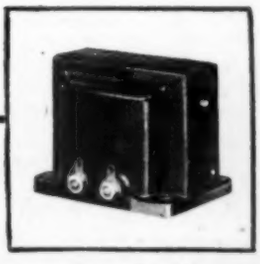


-30-

"Oh Boy! Here it is—did'ja bring the bread and cheese?"

RADIO NEWS

Technical BOOKS

"THE SERVICING OF TELEVISION RECEIVERS" by the *Philco Service Division.* Published by *Philco Corporation,* Philadelphia. 135 pages. Price $2.25.

Every radio serviceman should own a copy of this book against the day when he will be called upon to service television receivers in his shop.

In the brief span of 135 pages the men of the Service Division at *Philco* have managed to crowd an amazing amount of *practical* information. They have wisely left the discussion of television theory to the engineering texts and have gotten down to brass tacks to deal with some of the problems that will confront the serviceman who has to service the new television receivers now coming from the production lines.

The book is divided into five sections, the basic television system, the composite video signal, the television receiver, television antennas, and servicing the television receiver. Within this structure the authors have presented pictorial material, circuit diagrams and tables, all of which can be used at once by the serviceman.

For those servicemen who are located in areas already boasting of television service, this book is an immediate must. To those for whom television is a thing of the future, a word of warning—it is not too early to study up on the subject.

* * *

"COMMUNICATION THROUGH THE AGES" by Alfred Still. Published by *Murray Hill Books, Inc.,* New York. 194 pages. Price $2.75.

It was with the pleasure at meeting an old friend that this reviewer welcomed the third book from the pen of Mr. Still for, here again, the author has presented another interesting facet in the vast field of electricity, in the thoroughly readable style which characterizes all of Mr. Still's books.

The reader cannot help but feel that the author truly enjoys writing these little books—for so easy and natural is his style that the reader can easily visualize himself having a chat with Mr. Still on the subject rather than reading the story from the printed page.

This time the story deals with all forms of communication from sign language to modern television. The need to communicate with one's fellow man is a basic human need and an exposition of how men have gone about satisfying this desire through the years makes good reading.

This book should find a place in the bookshelves of many homes, both for its interest and the essential information it contains.

* * *

"RADIO'S CONQUEST OF SPACE" by Donald McNicol. Published by *Murray Hill Books, Inc.,* New York. 364 pages. Price $4.00.

That most people take radio for granted is a foregone conclusion, but at times it is well to look back and review the monumental work that has been accomplished in a relatively short space of time.

Evidently the author felt that just such a survey should be made, for Mr. McNicol, himself an engineer and past president of the I.R.E., has drawn on his vast experience and the memories of those still living who saw the beginnings of radio, to present this most readable story of the conquest of space.

While the presentation is non-technical, the author has not "written down" to an audience but assumes that, like himself, his readers are interested in some of the early experimental work done in the radio field.

This book should engender in the hearts of all who work in the radio industry a feeling of pride over the accomplishments of a vast group of scientists, both named and unknown, who in the short span of a lifetime have conceived and brought to fulfillment the industry as it stands today.

—30—

Spot Radio News

(*Continued from page* 18)

for experimental facsimile and picture transmission. Facsimile also includes, of course, transmitting newspapers over the air, hot off the press.

NOT ON THE immediate television horizon, but far enough along to have won favorable comments from FCC experts who saw it demonstrated recently, is the *Radio Corporation of America's* aviation device, Teleran. This is a televised blind flying system whereby a televised navigation map of the area over which the plane is flying appears continually on a screen on the plane's instrument panel. Superimposed over the televised map are radar blips which indicate every plane in the area at the altitude where the aircraft is flying. Changes in any flight condition are noted on the screen as quickly as they occur. *RCA* believes that Teleran promises to revolutionize post-war aerial navigation and remove a majority of the collision and bad-weather hazards now inherent in flying.

EQUALLY INTERESTING and doubtless a dramatic source for news stories of the future was a recent FCC announcement put out in routine fashion on the granting of authority to School District No. 9, Glacier County, Montana, to construct seven provisional stations. They will operate in the intermittent service on a temporary basis. Purpose: to be used as a safety and health-protection measure. School district headquarters plan to go on the air, especially during the winter months, when roads are bad and

snows are heavy. On the receiving end will be schools located in the isolated areas on the Blackfeet Indian Reservation, where telephones are lacking.

The school fathers were authorized by FCC "to engage in communications pertaining to safety of life and property and, secondly, to transmit essential communications relative to the district." Frequency 31.02 mc. has been awarded conditionally. Power is not to exceed 50 watts and there will be A3 and special emission for FM (telephony). Equipment will be determined subject to FCC approval. We like to imagine a teacher at one of the isolated schools getting the district superintendent on the phone to bawl out her worst pupil, but FCC insists that medical and health advice will be the most important matters for broadcast.

GERMANY, post-war model, was described the other night in the most vivid detail we've heard for some time by Lt. Col. Richard H. Ranger, a research engineer who recently brought back about a ton of Nazi electrical equipment. Details on it have been released to American industry by the Department of Commerce. He's a Signal Corps expert with a prewar background that included inventing a number of developments in facsimile picture transmission. Most of the highly technical fields in Germany he found pretty well wrecked, and further difficulty is being experienced gathering good technicians from the various zones of influence to put factory staffs together and begin postwar production.

Some progress has, however, been made—Col. Ranger himself was helpful in getting German newsreels back into operation. He also reports that they did wonders with color photography during the war, and showed some excellent movies to prove it. . . . His favorite gadget, which he demonstrated, he called the Magnetophone, a device for recording and reproducing sound on magnetized tape. It is said to do the best work of this kind to date, picking up sounds as light as minus 60 decibels. The best until Magnetophone was minus thirty. Col. Ranger demonstrated his finds before the *Institute of Radio Engineers* at a meeting in Washington.

—30—

ERRATA

Through a typographical error, R_8, R_{15} in the parts list on page 37 of the Oct. issue was shown incorrectly. The value should be 270,000 ohm, ½ w. resistor.

In the Oct. issue, page 41, the value of R_{13} should be 25,000 ohm, 3 w. res. instead of 25,000 ohm, ½ w. res.

Photo Credits

Pages	Credit
25, 27, 138	U. S. Army Air Forces
30, 92	Walter Steinhard, Staff Photographer
32, 33, 34, 154	General Electric
36	Superior Instruments Co.
44	Sylvania Electric Company
46, 47, 80	Packard-Bell Company
48	U. S. Army Signal Corps
51 (top left)	Proctor Electric Company by Arthur Haug, Staff Photographer
51 (top right)	Electronic Corporation of America
88	Press Wireless
122	Raytheon
139	Electronic Laboratories

INDEX OF ADVERTISERS

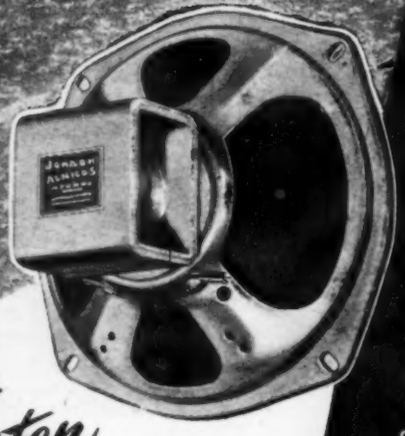
January 1947

Listen!

2 NEW Jensen

Extended Range High-Fidelity

PM SPEAKERS



These two Jensen speakers, with *ALNICO 5* PM design, provide excellent high-fidelity performance. Excellent as replacement and modernizing units for FM and television receivers, radio-phonograph combinations, for studio monitoring, wired music, and for similar applications. Installed in Jensen *Bass Reflex** cabinets, they provide exceptionally high-quality reproduction with added octaves of bass response.

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Model P8-SH (Superseding PM8-CT). A high-fidelity 8-inch *ALNICO 5* PM speaker. Recommended for use with Jensen Model A-81 *Bass Reflex* cabinet. Maximum power handling capacity in speech and music systems, 6 watts. . . . Voice coil impedance, 6-8 ohms,

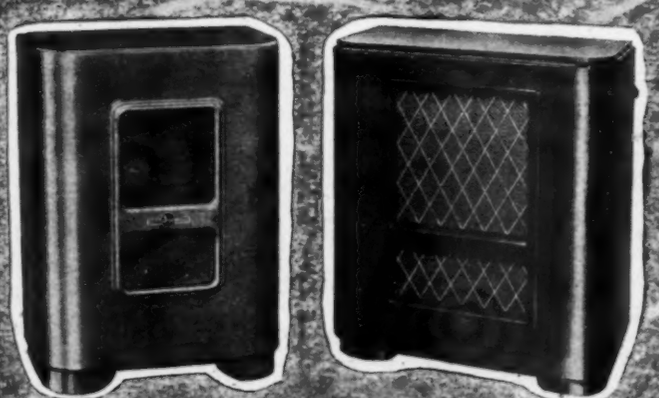
Standard Fidelity Model P8-S. Voice coil impedance, 3-4 ohms. Maximum power handling capacity in speech and music systems. 8 watts.

Listen ...it's a Jensen SPEAKER

Model P12-SH (Superseding PM12-CT). A new 12-inch high-fidelity *ALNICO 5* PM speaker. Designed for use with Jensen Model A-121 or Model D-121 *Bass Reflex* cabinets. Maximum power handling capacity in speech and music systems, 8 watts. Voice coil impedance, 6-8 ohms.

Standard Fidelity Model P12-S. Voice coil impedance 6-8 ohms. Power handling capacity in speech and music systems. 10 watts.

BASS REFLEX CABINETS



Model A-81— for Model P8-SH speaker

Model A-121— for Model P12-SH speaker

Model [illegible] for Model P12-SH speaker

Jensen

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